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(54) **THERMAL FRAME FOR A REFRIGERATED ENCLOSURE**

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A47F 3/04 (2006.01)
E06B 1/04 (2006.01)

(52) **U.S. Cl.**
CPC ***F25D 23/065*** (2013.01); ***A47F 3/0426*** (2013.01); ***E06B 1/04*** (2013.01); ***F25D 23/063*** (2013.01); ***F25D 23/069*** (2013.01); *F25D 2201/10* (2013.01); *F25D 2201/14* (2013.01)

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USPC 49/504
See application file for complete search history.

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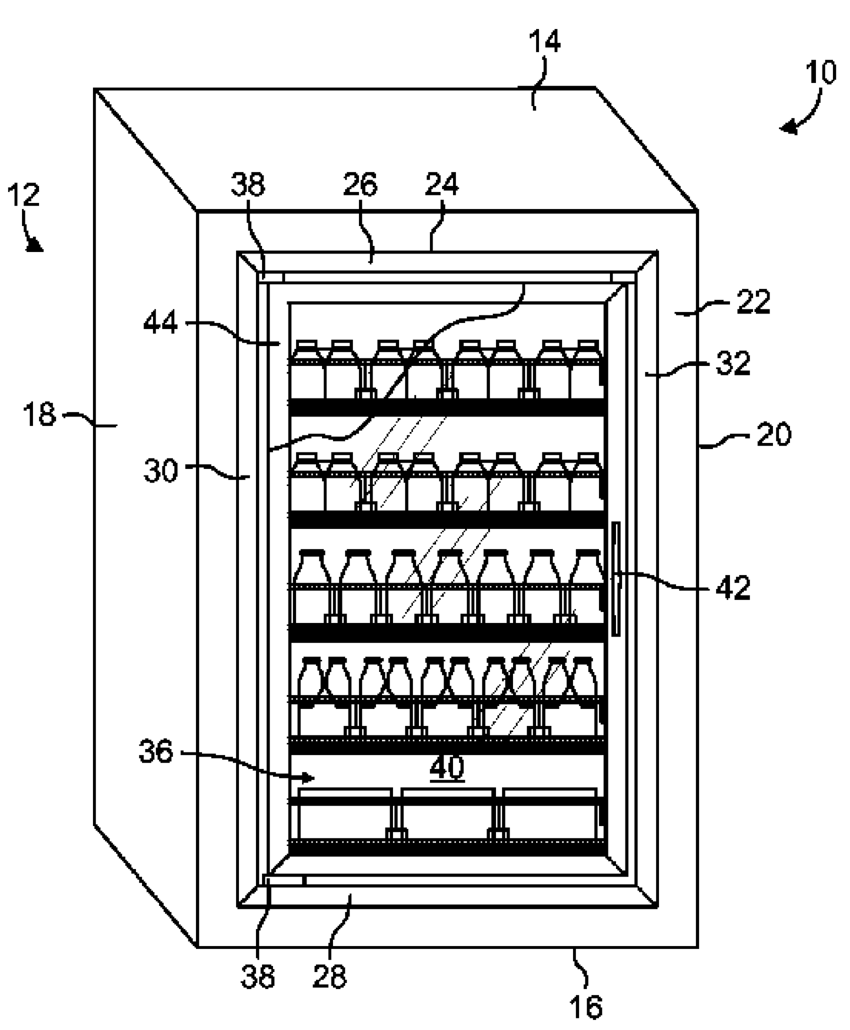
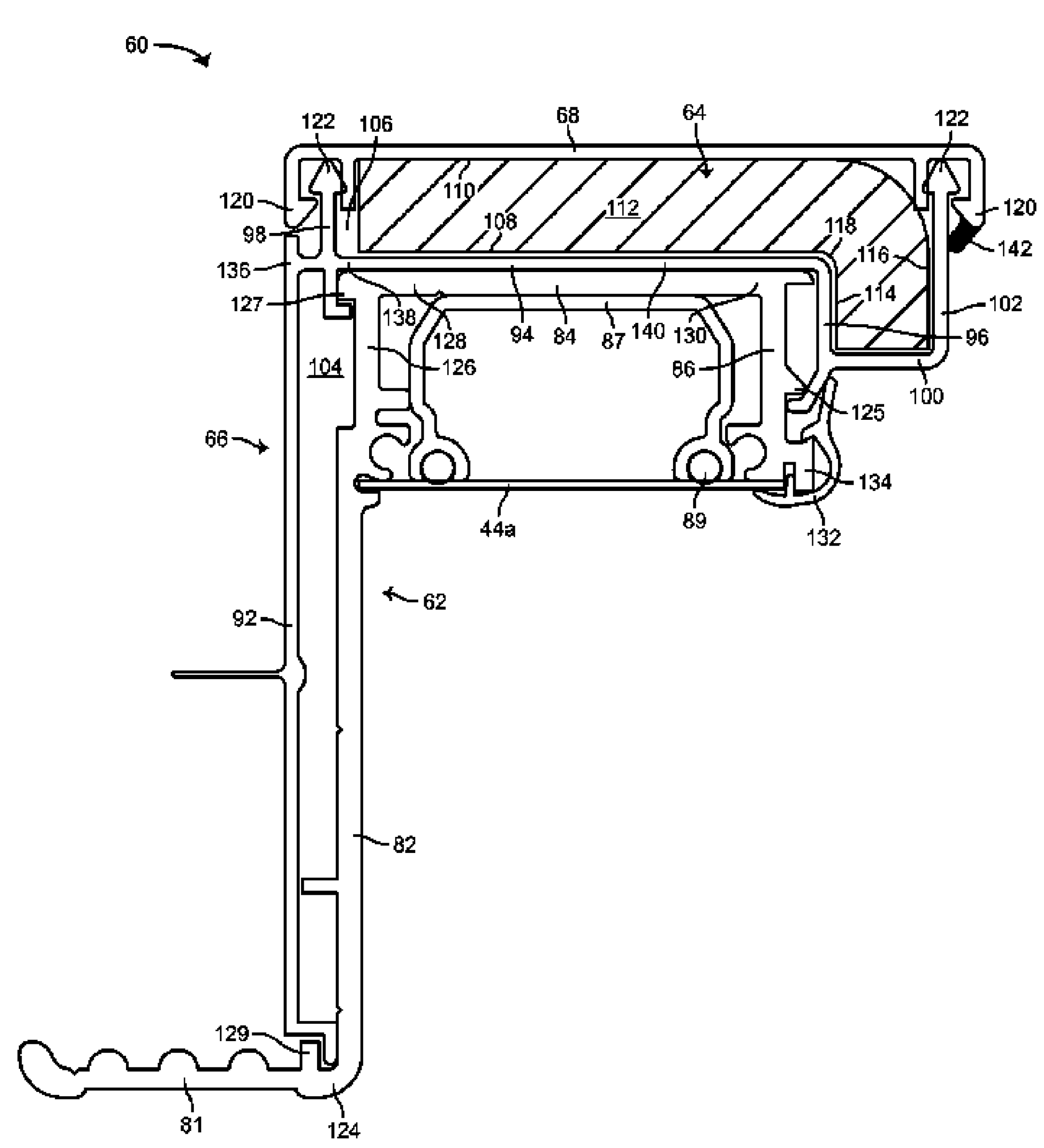
(57) **ABSTRACT**

A thermal frame for an opening in a refrigerated enclosure includes a perimeter frame segment fixed to the refrigerated enclosure along a perimeter of the opening. The thermal frame includes a first vacuum panel fixed relative to the perimeter frame segment and configured to reduce heat transfer through the perimeter frame segment. The thermal frame may include a mullion frame segment fixed to the refrigerated enclosure and dividing the opening into a plurality of smaller openings. The thermal frame may include a second vacuum panel fixed relative to the mullion frame segment and configured to reduce heat transfer through the mullion frame segment.

20 Claims, 11 Drawing Sheets





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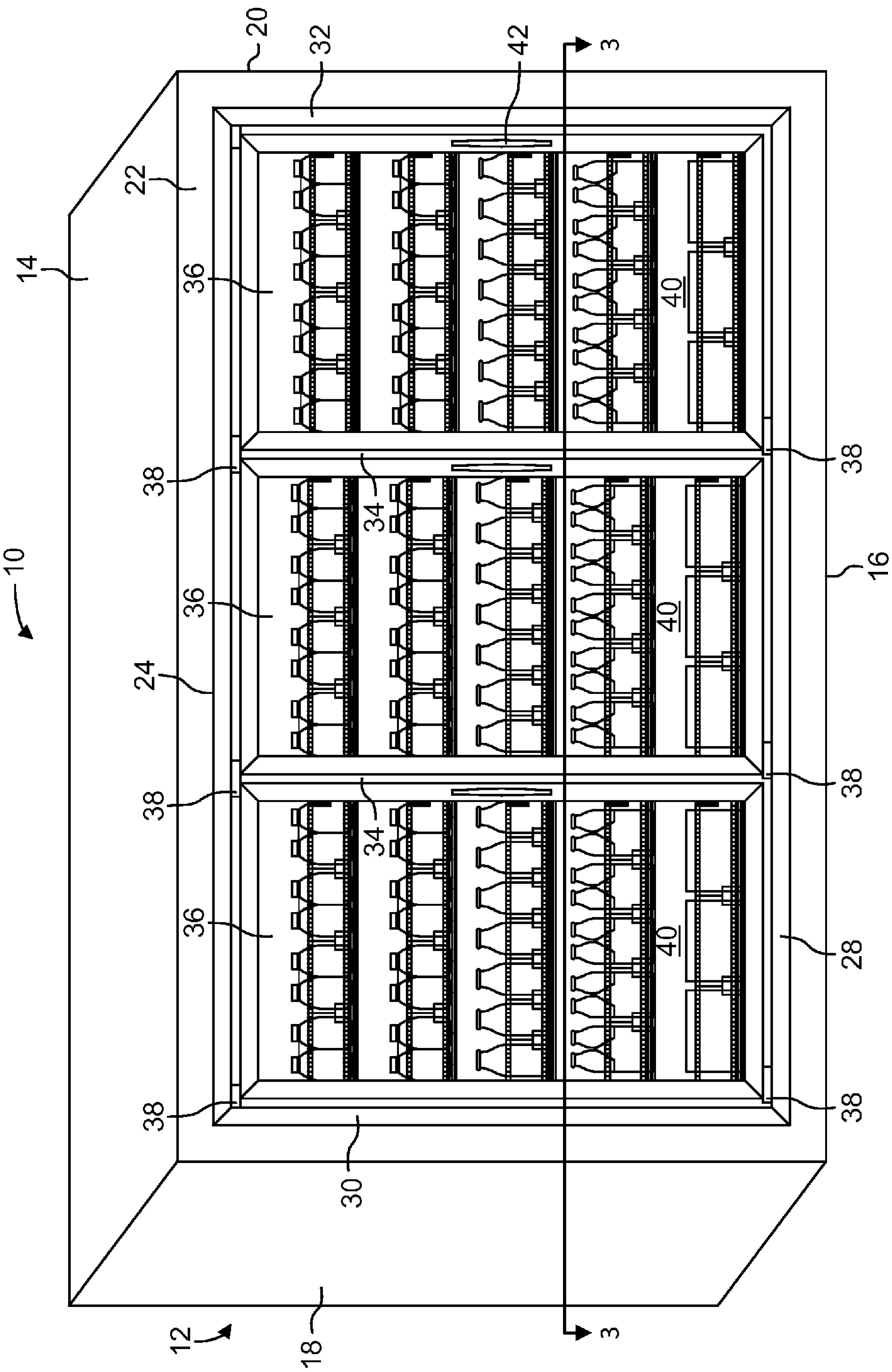

FIG. 1

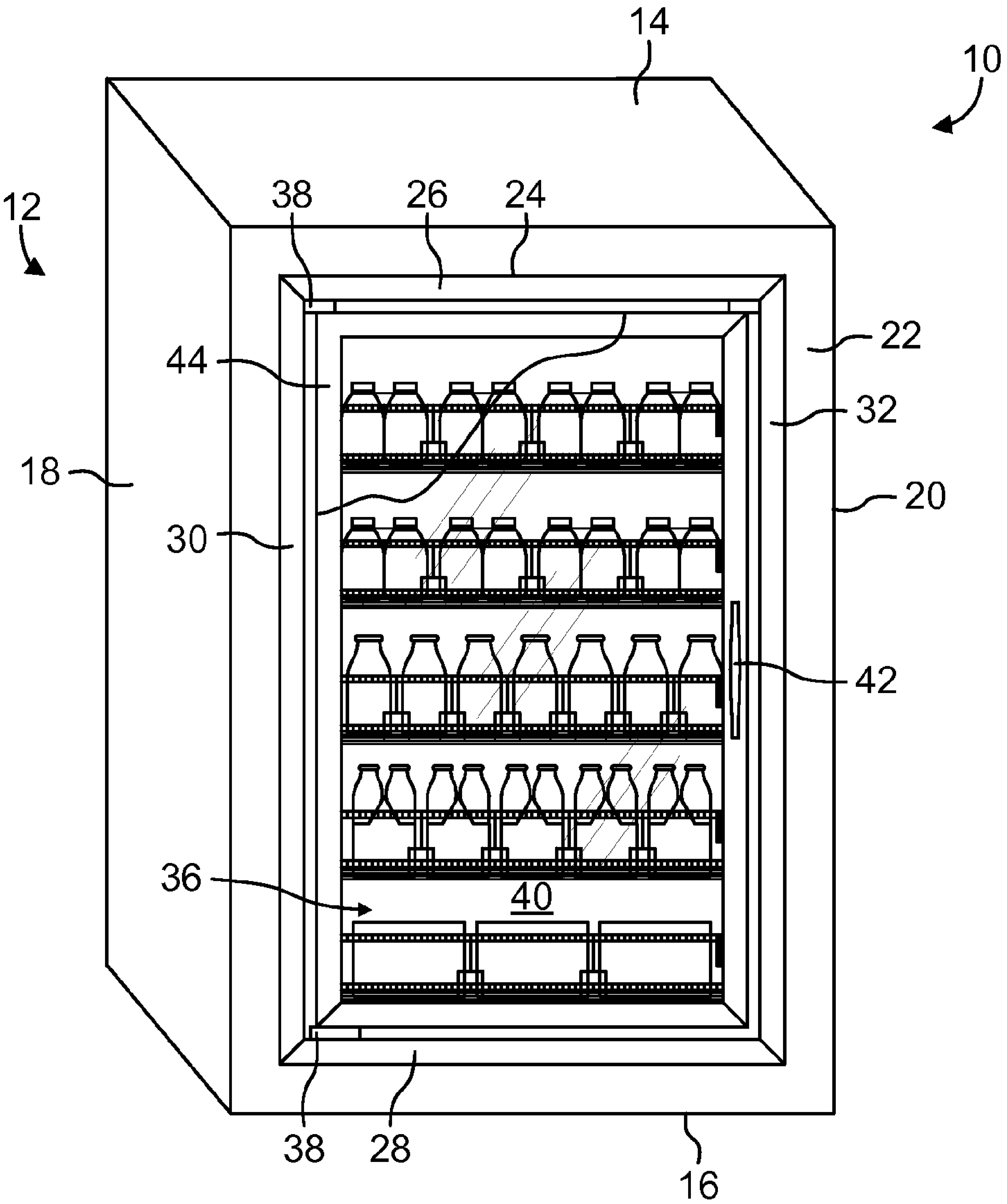

FIG. 2

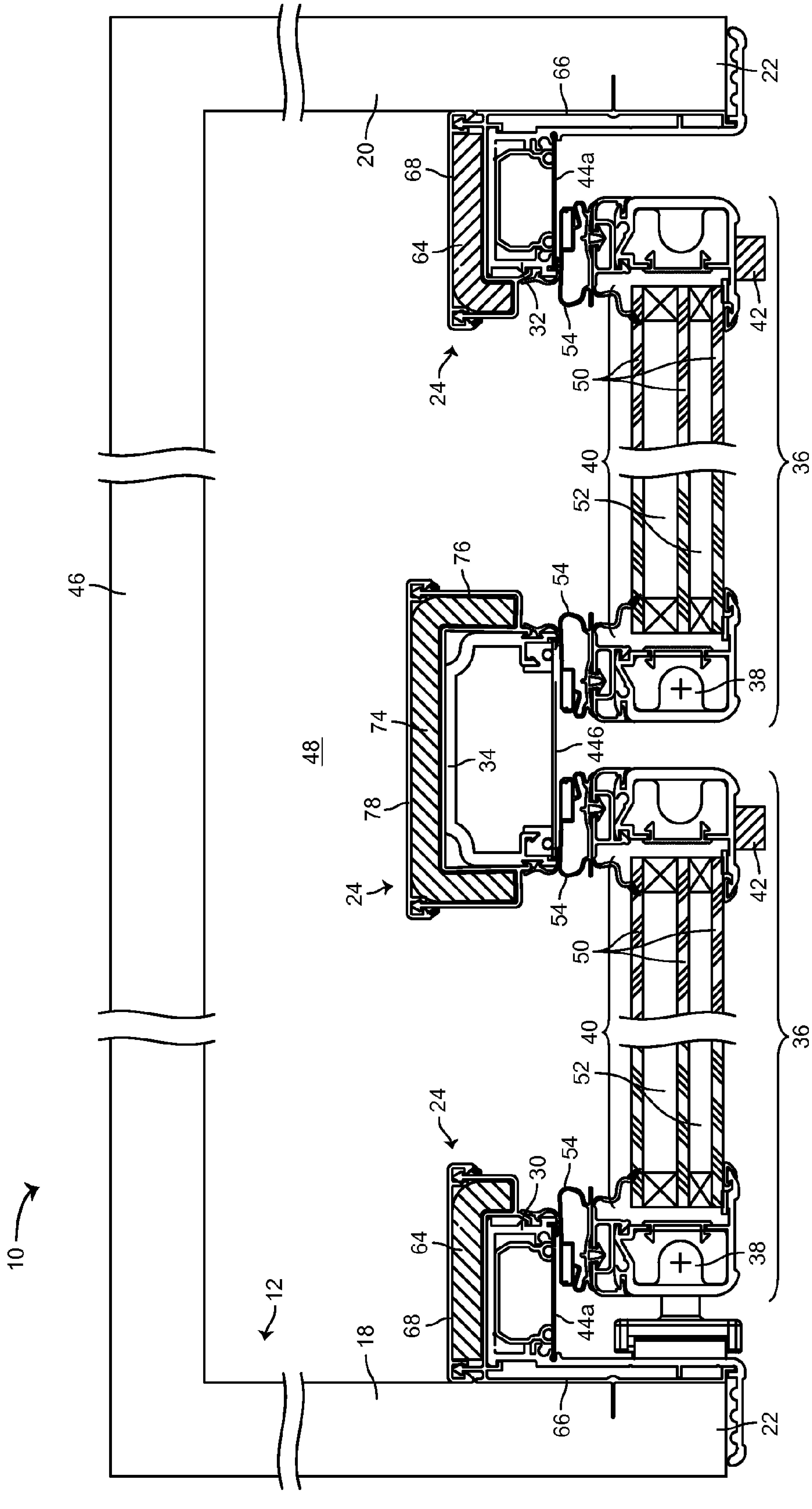
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FIG. 3

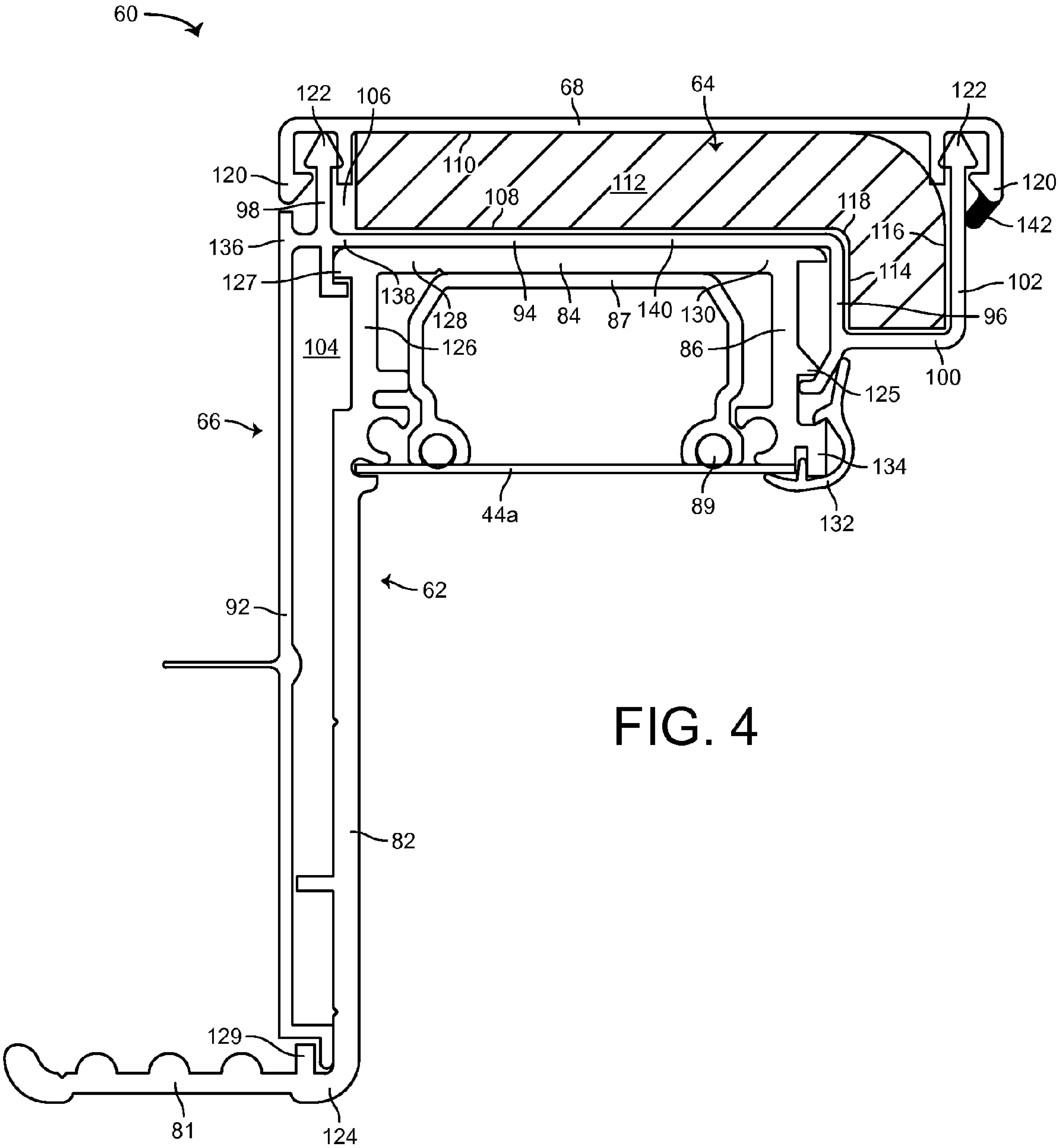

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FIG. 4

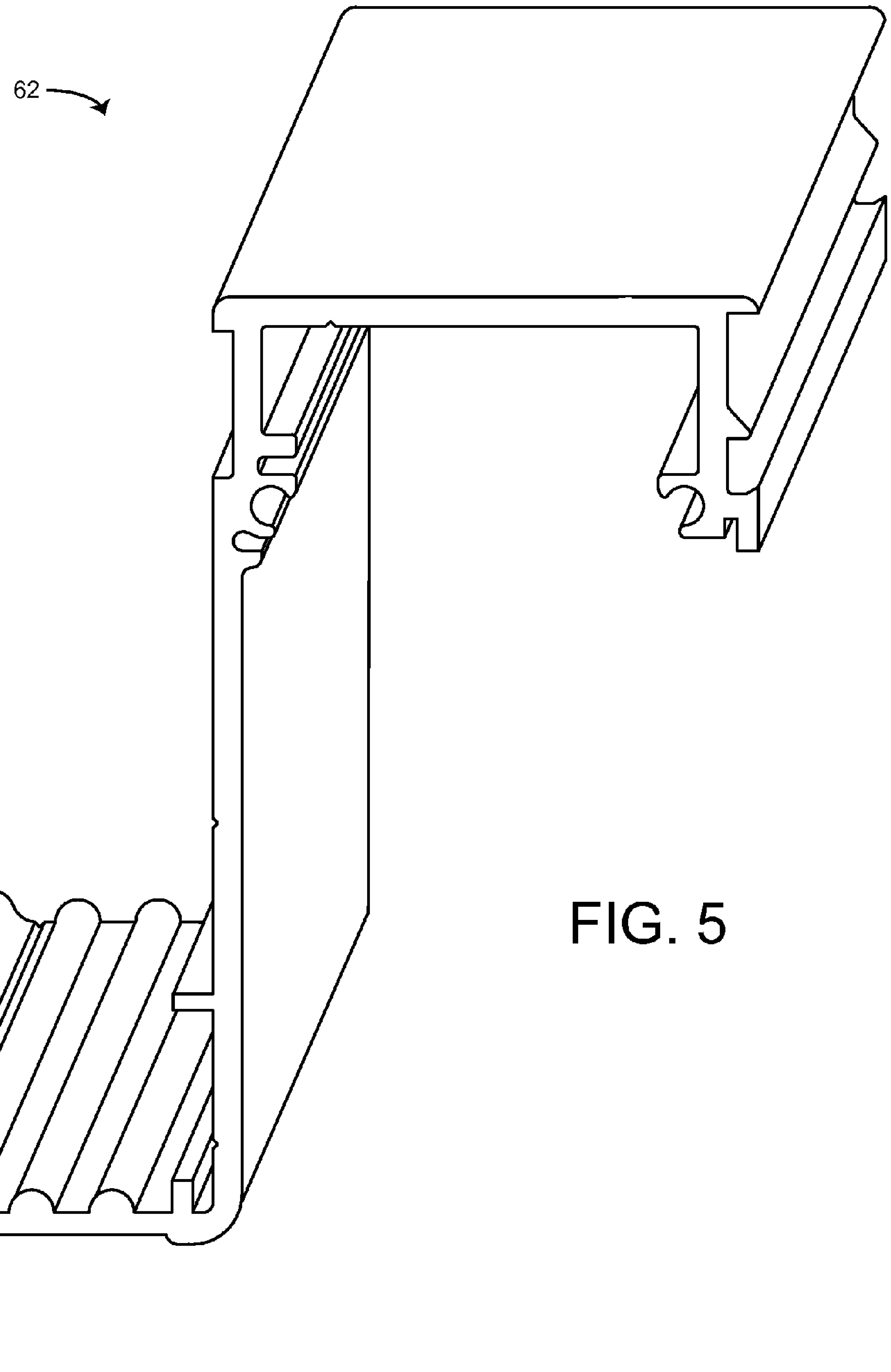


FIG. 5

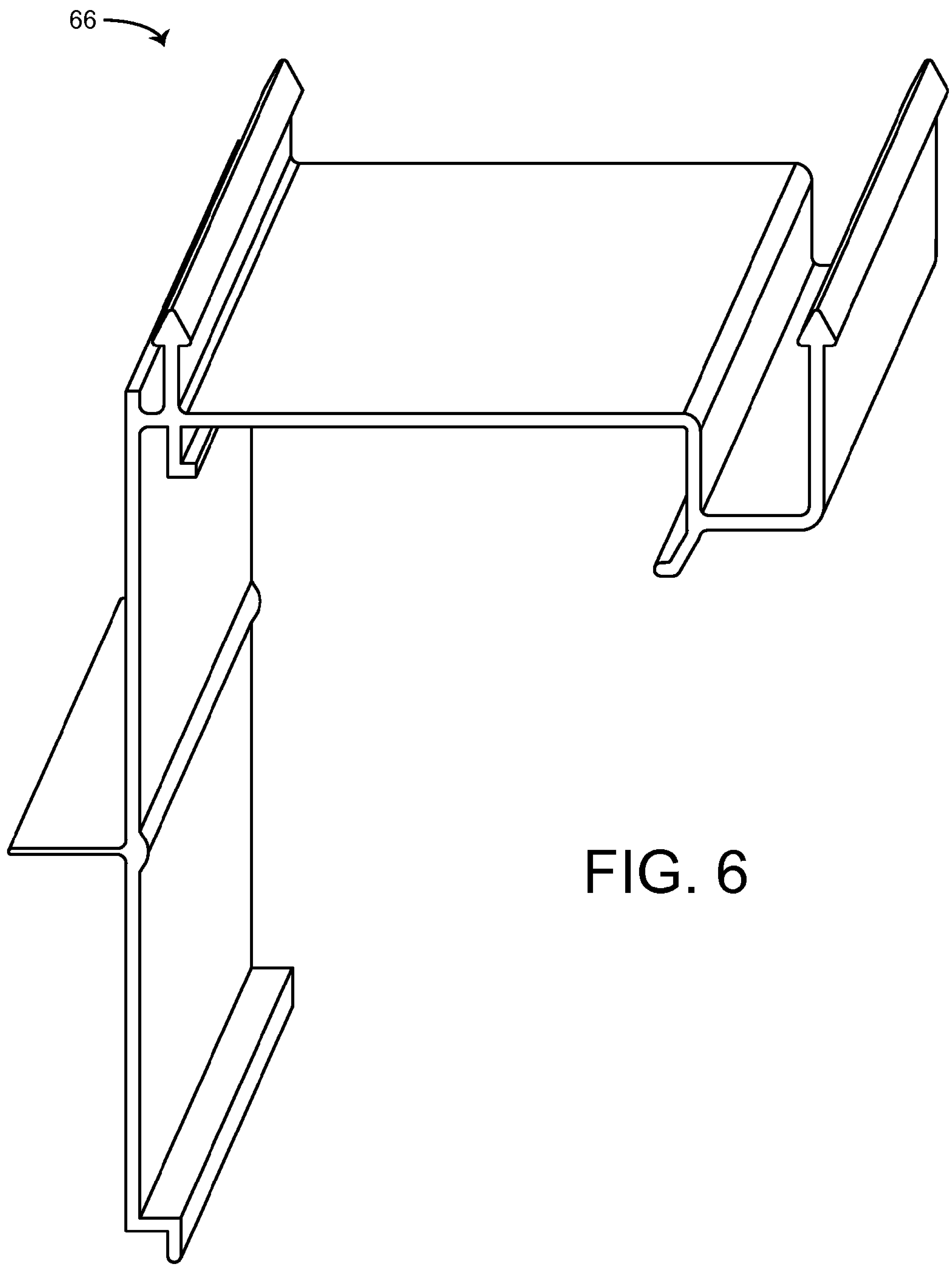
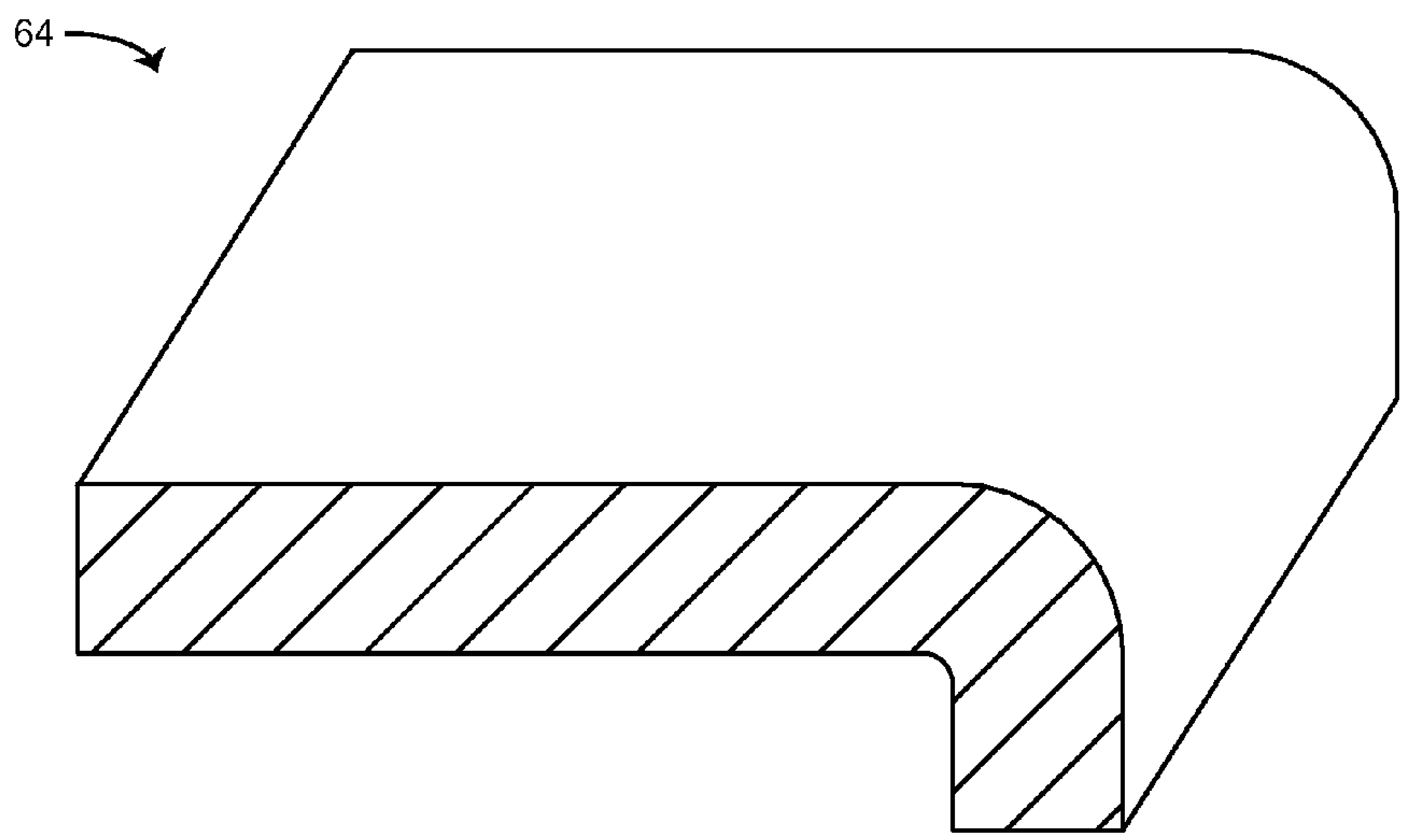


FIG. 6



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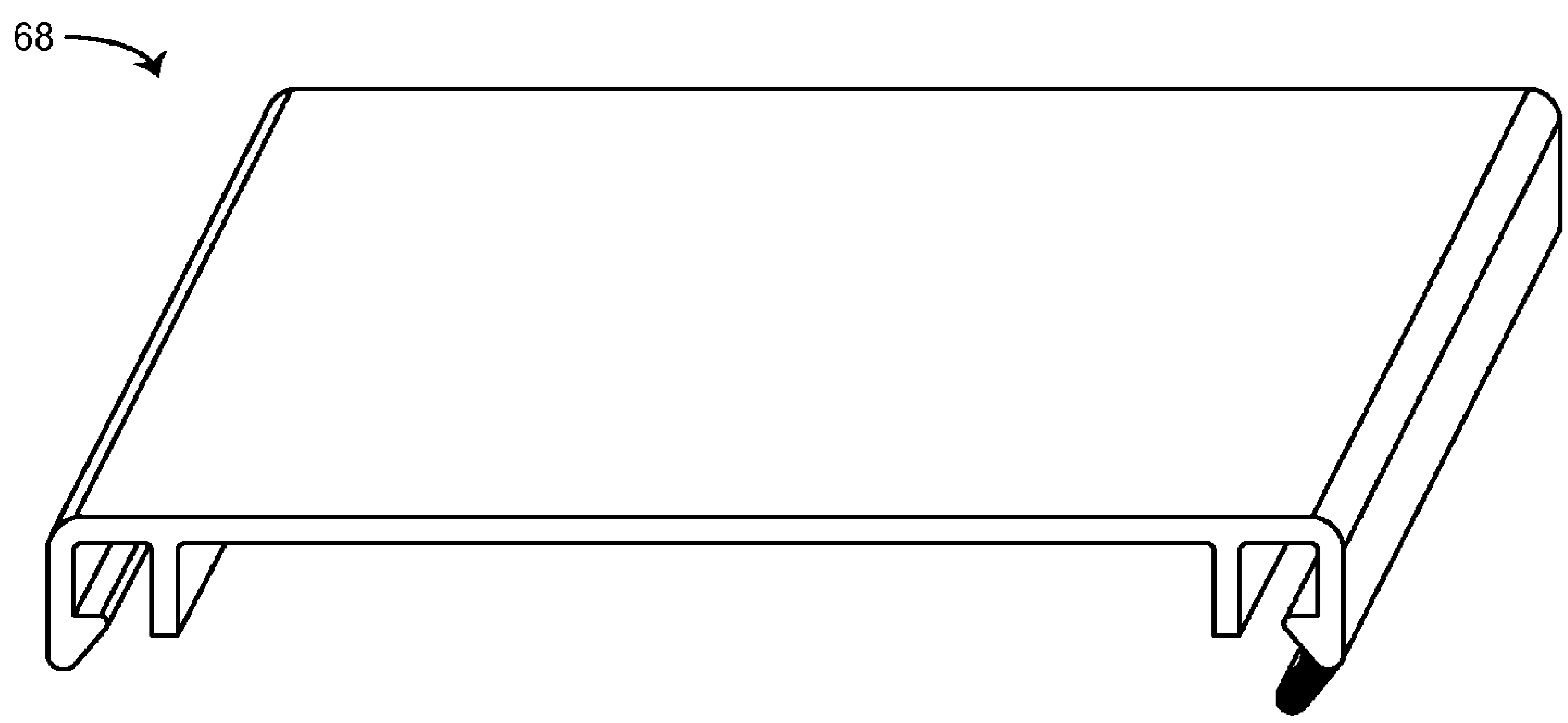

FIG. 8

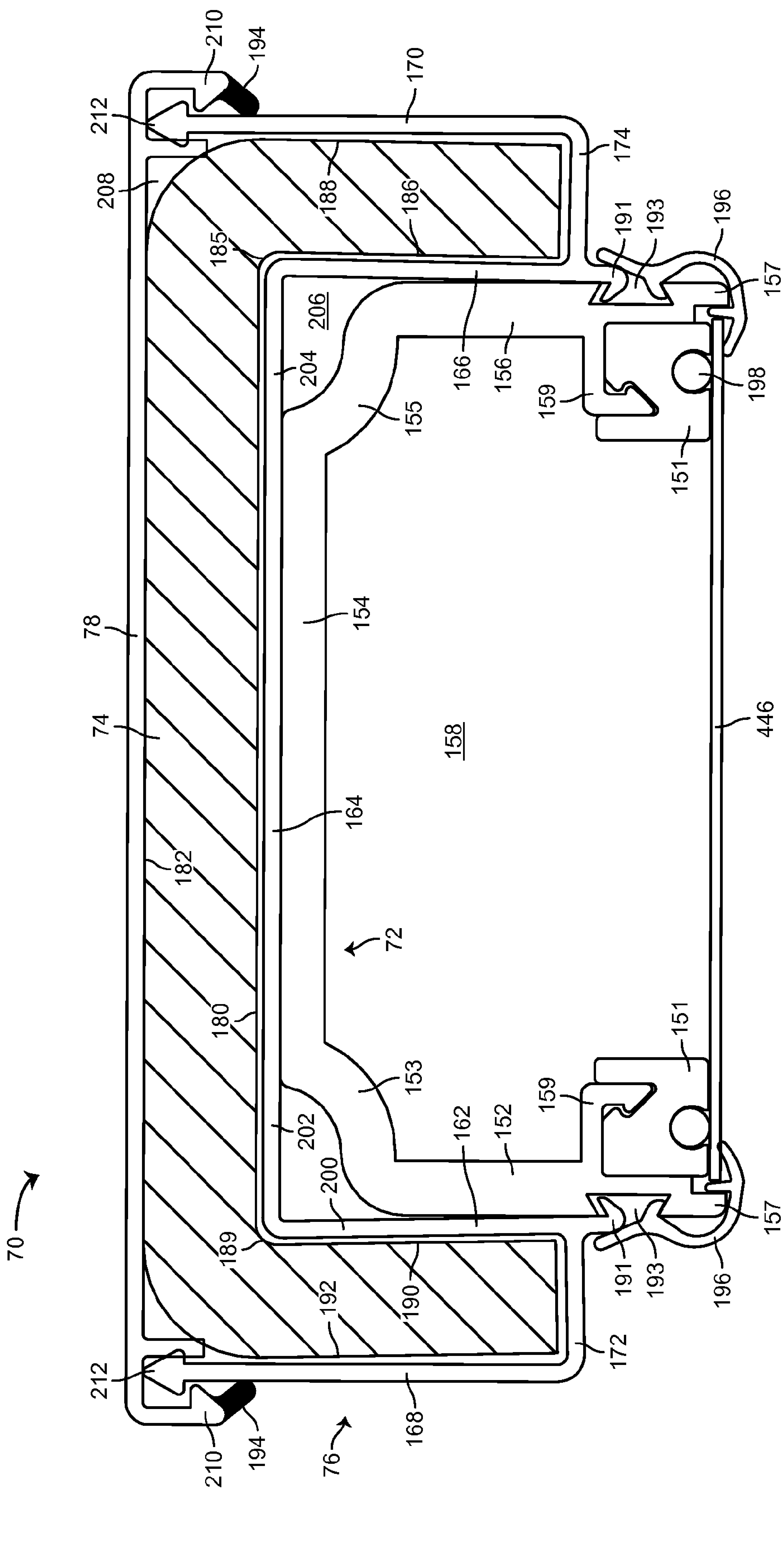
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FIG. 9

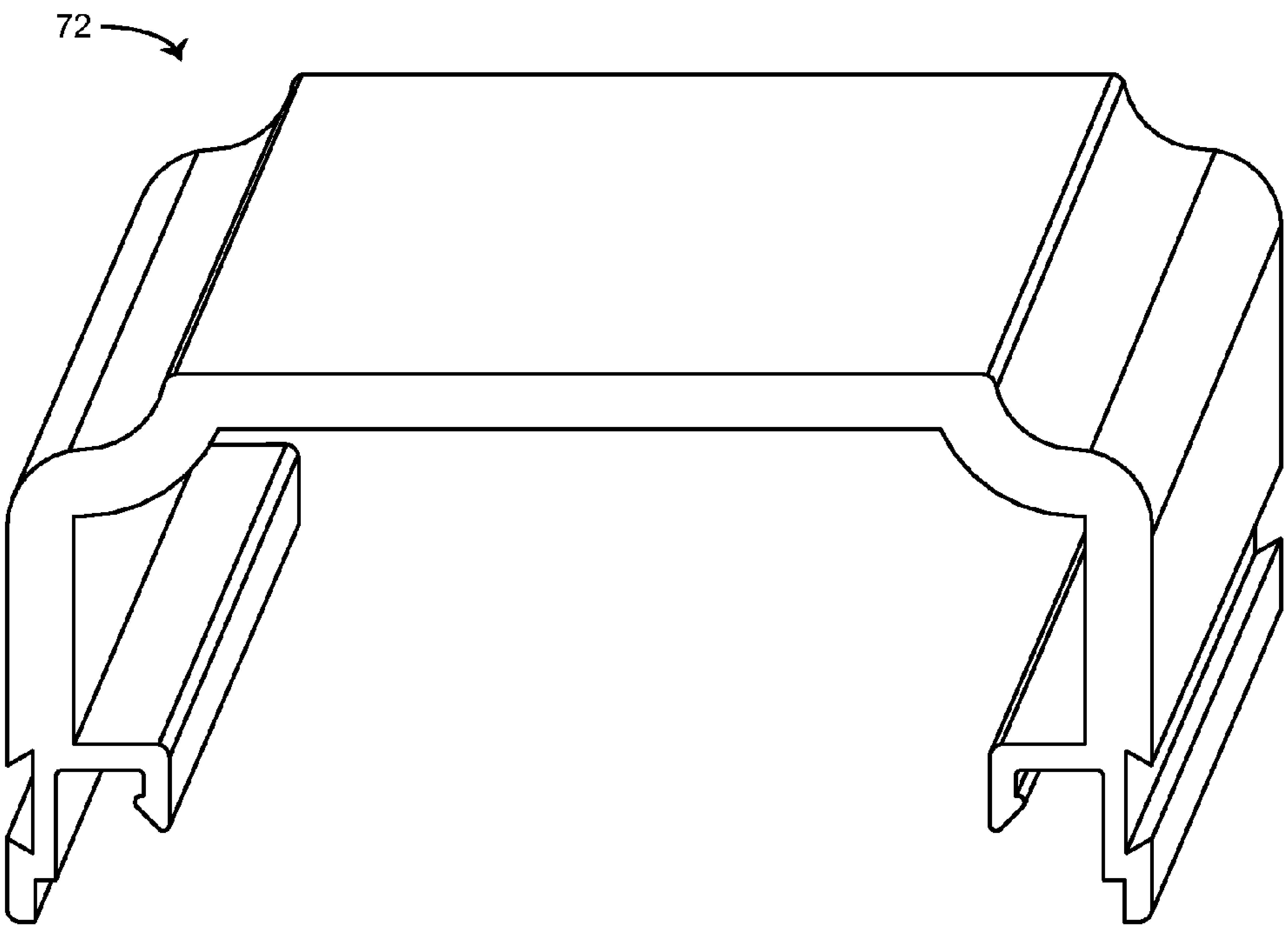

FIG. 10

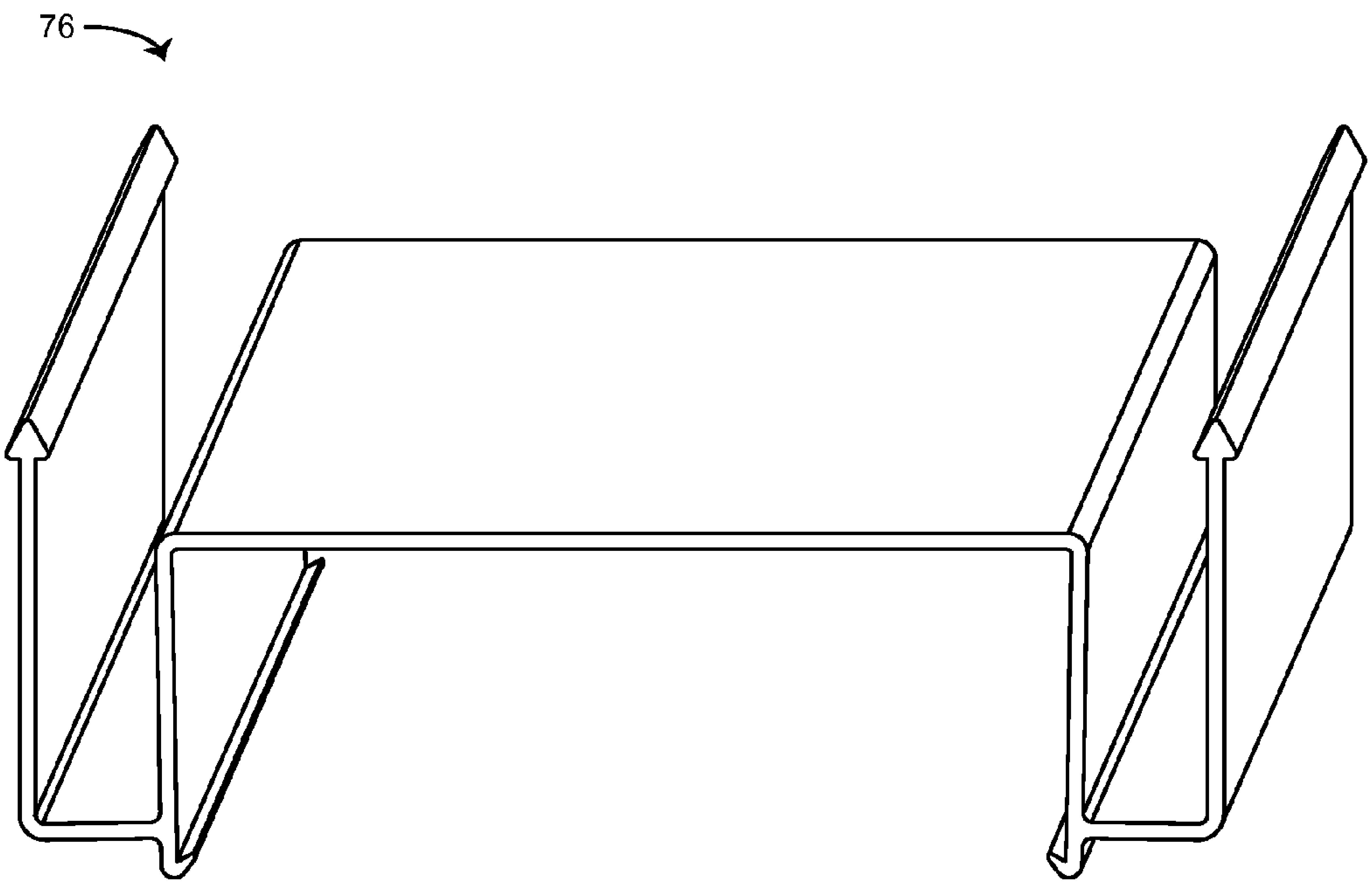

FIG. 11

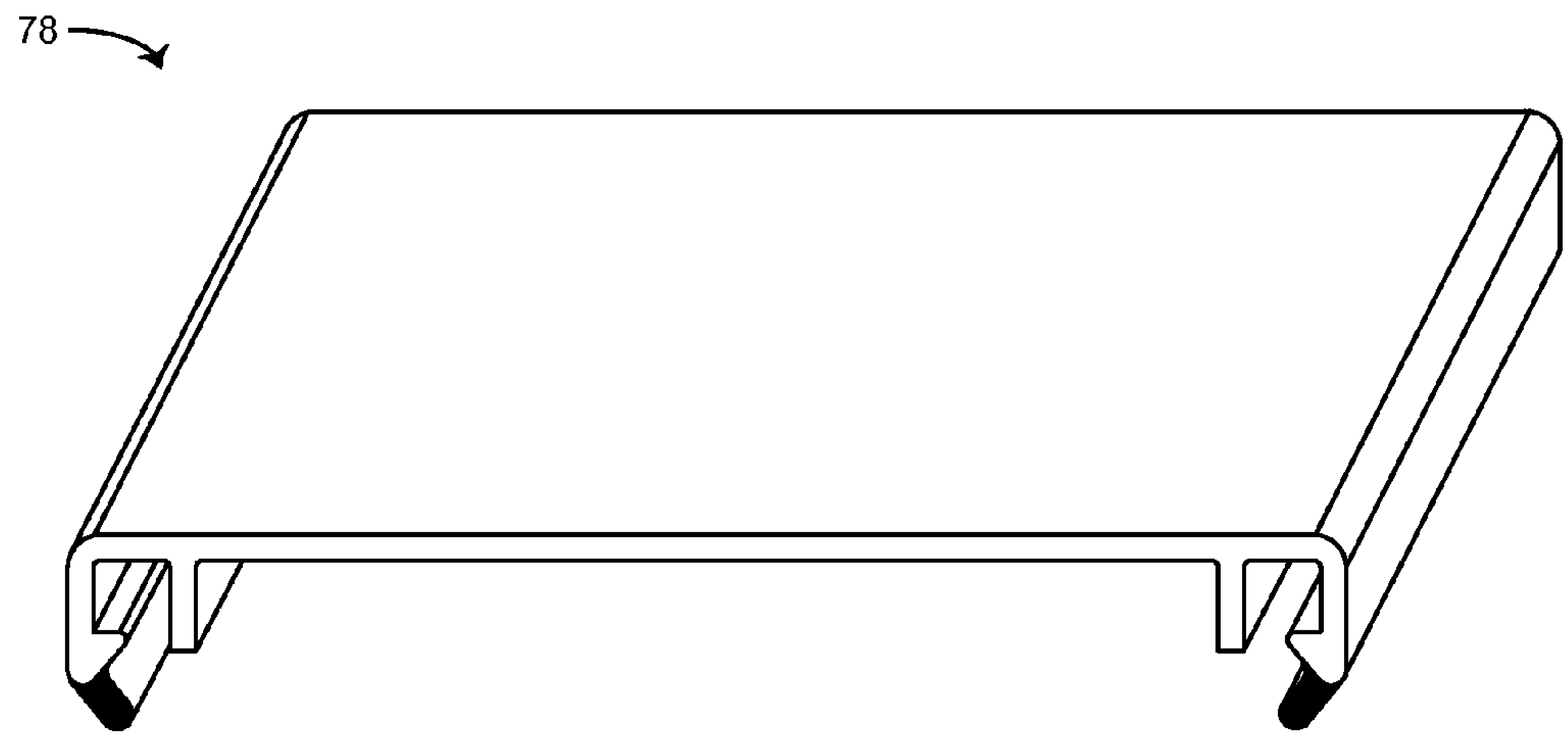

FIG. 12

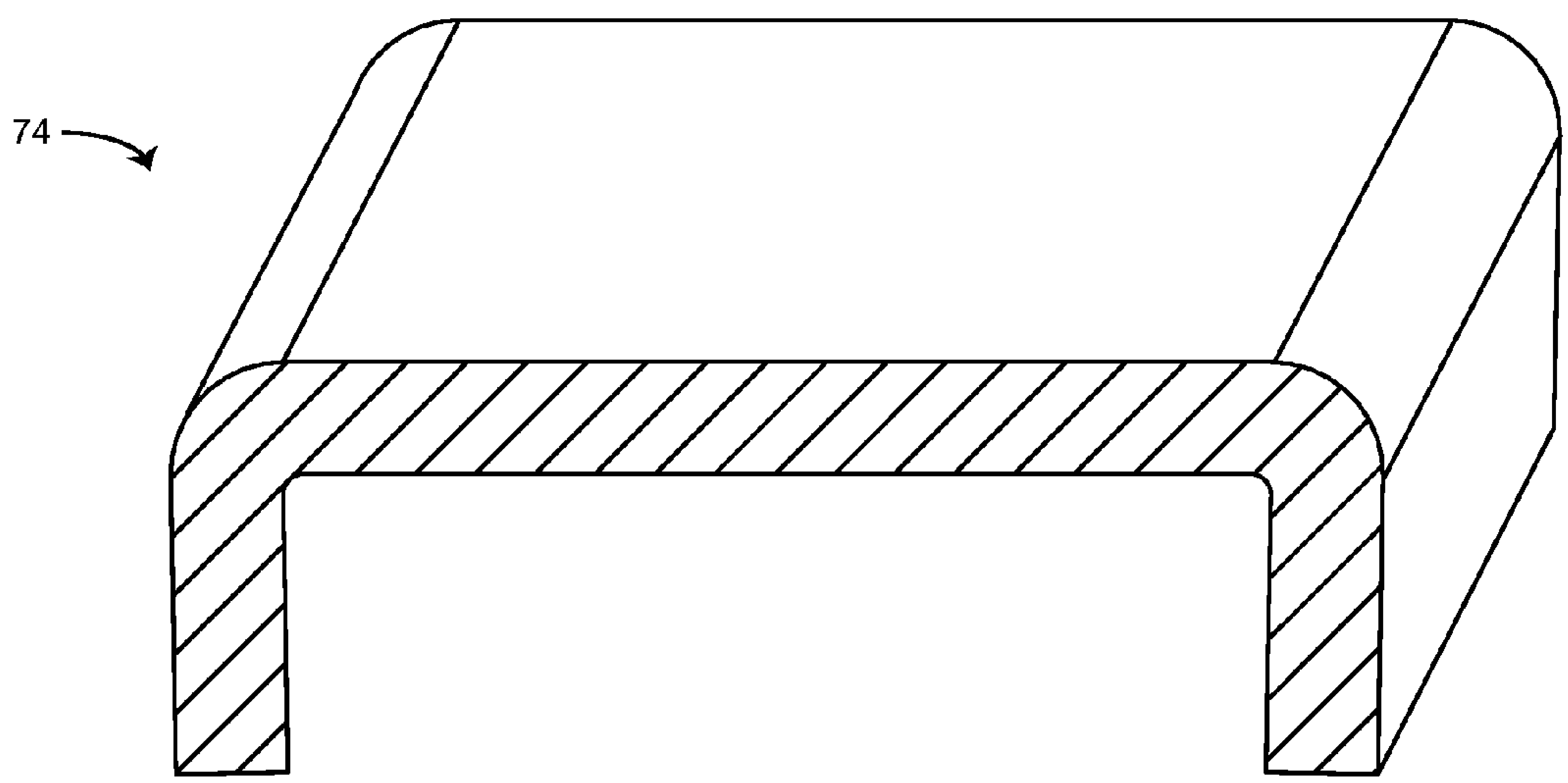

FIG. 13

THERMAL FRAME FOR A REFRIGERATED ENCLOSURE

BACKGROUND

The present invention relates generally to the field of refrigerated enclosures (e.g., refrigerators, freezers, refrigerated merchandisers, etc.) for storing and/or displaying refrigerated or frozen objects. The present invention relates more particularly to a thermal frame for a refrigerated enclosure. The present invention relates more particularly still to a thermal frame that includes a vacuum panel for improved thermal insulation.

Refrigerated enclosures are used in commercial, institutional, and residential applications for storing and/or displaying refrigerated or frozen objects. The term "refrigerated" is used herein to refer both to refrigerators at temperatures above freezing and to freezers at temperatures below freezing. Refrigerated enclosures typically have one or more user-operable doors or windows for accessing refrigerated or frozen objects within a temperature-controlled space.

One type of refrigerated enclosure is a refrigerated display case. Refrigerated display cases are used to display products that must be stored at relatively low temperatures and often include shelves, glass doors and/or glass walls to permit viewing of the products supported by the shelves. For example, grocery stores, supermarkets, convenience stores, florist shops, and other commercial settings often use self-service type refrigerated display cases or merchandisers to store and display temperature-sensitive consumer goods (e.g., food products and the like).

Another type of refrigerated enclosure is a refrigerated storage unit. Refrigerated storage units are commonly found in warehouses, restaurants and lounges. Refrigerated storage units may also include shelves and are used to store food, beverages and other items stored at relatively low temperatures. Refrigerated display cases and storage units may be free standing units or "built in" units that form an actual part of the building in which they are located.

Whether free standing or built in, refrigerated enclosures typically include a frame that supports one or more doors or windows. The frame may define a forward portion of the surrounding enclosure and may include top, bottom, and side members. In instances where the frame supports more than one door, the frame may also include one or more vertically extending mullions. Traditional frames are made of a structurally reliable material such as aluminum, steel, or other metals; however, such materials are often poor thermal insulators. Other frames are made of plastics or filled with an insulating foam; however, such materials often lack structural integrity and reliability. Accordingly, it would be desirable to provide a frame for a refrigerated enclosure that overcomes these and/or other disadvantages.

SUMMARY

One implementation of the present disclosure is a thermal frame for an opening in a refrigerated enclosure. The thermal frame includes a perimeter frame segment fixed to the refrigerated enclosure along a perimeter of the opening. The perimeter frame segment includes a first wall extending rearwardly from a frontal portion of the refrigerated enclosure, a second wall extending in a second direction from a rearward edge of the first wall, and a third wall extending from the second wall toward the frontal portion of the refrigerated enclosure to define a first channel between the first, second, and third walls. The thermal frame further includes a vacuum panel fixed relative to the perimeter frame segment. The vacuum panel includes a first surface disposed rearward of the second wall, a second surface disposed rearward of the first surface and offset from the first surface by a thickness, and an evacuated chamber between the first and second surfaces.

The vacuum panel may be configured to reduce heat transfer through the perimeter frame segment. In some embodiments, the vacuum panel has a thermal resistance between

$$25\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\ \text{F.}}{\text{BTU}}$$

per inch of the thickness and

$$100\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\ \text{F.}}{\text{BTU}}$$

per inch of the thickness.

In some embodiments, the vacuum panel includes at least one bend and the evacuated chamber is a continuous chamber bridging the bend. For example, the vacuum panel may include a third surface extending from the first surface toward the frontal portion of the refrigerated enclosure, and a fourth surface extending from the second surface toward the frontal portion of the refrigerated enclosure and offset from the third surface by the thickness in the second direction. The evacuated chamber may extend between the third and fourth surfaces.

In some embodiments, the thermal frame includes a mounting bracket configured to secure the perimeter frame segment to the perimeter of the opening and to support the vacuum panel. The perimeter frame segment may include a flange projecting from the third wall and the mounting bracket may be coupled to the perimeter frame segment via the flange.

In some embodiments, the mounting bracket includes a fourth wall disposed between the first wall of the perimeter frame segment and the perimeter of the opening, a fifth wall disposed between the second wall of the perimeter frame segment and the first surface of the vacuum panel and extending in the second direction from a rearward edge of the fourth wall, and a sixth wall extending from the fifth wall toward the frontal portion of the refrigerated enclosure to define a second channel between the fourth, fifth, and sixth walls. The perimeter frame segment may be located at least partially within the second channel.

In some embodiments, the mounting bracket includes a fifth wall disposed between the second wall of the perimeter frame segment and the first surface of the vacuum panel, a seventh wall coupled to a first end of the fifth wall and extending rearward of the fifth wall, and an eighth wall coupled to a second end of the fifth wall, opposite the first end, and extending rearward of the fifth wall. The fifth, seventh, and eighth walls may at least partially define a third channel within which the vacuum panel is contained.

In some embodiments, the eighth wall is offset from the sixth wall in the second direction and the mounting bracket further includes a sixth wall extending from the second end of the fifth wall toward the frontal portion of the refrigerated enclosure and a ninth wall extending between the sixth wall and the eighth wall to define a portion of the third channel between the sixth, eighth, and ninth walls.

In some embodiments, the thermal frame further includes a cover extending between the seventh and eighth walls and closing the third channel. The cover may include a first engagement feature located along a first edge of the cover and configured to engage a corresponding engagement feature of the seventh wall and a second engagement feature located along a second edge of the cover and configured to engage a corresponding engagement feature of the eighth wall.

In some embodiments, the thermal frame further includes a contact plate extending between the first and third walls and closing the first channel. The thermal frame may further include a retaining clip coupled to the third wall of the perimeter frame segment and configured to hold the contact plate in position between the first and third walls.

Another implementation of the present disclosure is thermal frame for an opening in a refrigerated enclosure. The thermal frame includes a mullion frame segment fixed to the refrigerated enclosure and dividing the opening into a plurality of smaller openings. The mullion frame segment includes a first wall extending rearwardly relative to a frontal portion of the refrigerated enclosure, a second wall extending in a second direction from a rearward edge of the first wall, and a third wall extending from the second wall toward the frontal portion of the refrigerated enclosure to define a first channel between the first, second, and third walls. The thermal frame further includes a vacuum panel fixed relative to the mullion frame segment. The vacuum panel includes a first surface disposed rearward of the second wall, a second surface disposed rearward of the first surface and offset from the first surface by a thickness, and an evacuated chamber between the first and second surfaces.

The vacuum panel may be configured to reduce heat transfer through the mullion frame segment. In some embodiments, the vacuum panel has a thermal resistance between

$$25\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\text{ F.}}{\text{BTU}}$$

per inch of the thickness and

$$100\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\text{ F.}}{\text{BTU}}$$

per inch of the thickness.

In some embodiments, the vacuum panel includes at least one bend and the evacuated chamber is a continuous chamber bridging the bend. For example, the vacuum panel may include a third surface extending from a first edge of the first surface toward the frontal portion of the refrigerated enclosure and a fourth surface extending from a first edge of the second surface toward the frontal portion of the refrigerated enclosure and offset from the third surface by the thickness in the second direction. The evacuated chamber may extend between the third and fourth surfaces. In some embodiments, the vacuum panel includes a fifth surface extending from a second edge of the first surface and toward the frontal portion of the refrigerated enclosure and a sixth surface extending from a second edge of the second surface toward the frontal portion of the refrigerated enclosure and offset from the fifth surface by the thickness in a third direction opposite the second direction. The evacuated chamber may extend between the fifth and sixth surfaces.

In some embodiments, the mullion frame segment includes an inverted fillet connecting the second wall with at least one of the first wall and the third wall. The inverted fillet may include a convex surface along an interior of the first channel and a concave surface along an exterior of the first channel.

In some embodiments, the thermal frame includes a mounting bracket configured to secure the vacuum panel to the mullion frame segment. The mullion frame segment may include a flange projecting from at least one of the first wall and the third wall, and the mounting bracket may be coupled to the mullion frame segment via the flange.

In some embodiments, the mounting bracket includes a fourth wall extending rearwardly along an exterior surface of the first wall, a fifth wall disposed between the second wall of the mullion frame segment and the first surface of the vacuum panel and extending in the second direction from a rearward edge of the fourth wall, and a sixth wall extending from the fifth wall toward the frontal portion of the refrigerated enclosure to define a second channel between the fourth, fifth, and sixth walls. The mullion frame segment may be located at least partially within the second channel.

In some embodiments, the mounting bracket includes a fifth wall disposed between the second wall of the mullion frame segment and the first surface of the vacuum panel, a seventh wall coupled to a first end of the fifth wall and extending rearward of the fifth wall, and an eighth wall coupled to a second end of the fifth wall, opposite the first end, and extending rearward of the fifth wall. The fifth, seventh, and eighth walls may at least partially define a third channel within which the vacuum panel is contained.

In some embodiments, the seventh wall is offset from the first wall in a third direction opposite the second direction and the mounting bracket further includes a fourth wall extending from the first end of the fifth wall toward the frontal portion of the refrigerated enclosure and a ninth wall extending between the fourth wall and the seventh wall to define a portion of the third channel between the fourth, seventh, and ninth walls.

In some embodiments, the eighth wall is offset from the third wall in the second direction and the mounting bracket further includes a sixth wall extending from the second end of the fifth wall toward the frontal portion of the refrigerated enclosure and a tenth wall extending between the sixth wall and the eighth wall to define a portion of the third channel between the sixth, eighth, and tenth walls.

In some embodiments, the thermal frame includes a cover extending between the seventh and eighth walls and closing the third channel. The cover may include a first engagement feature located along a first edge of the cover and configured to engage a corresponding engagement feature of the seventh wall and a second engagement feature located along a second edge of the cover and configured to engage a corresponding engagement feature of the eighth wall.

Another implementation of the present disclosure is a thermal frame for an opening in a refrigerated enclosure. The thermal frame includes a perimeter frame segment fixed to the refrigerated enclosure along a perimeter of the opening, a mullion frame segment fixed to the refrigerated enclosure and dividing the opening into a plurality of smaller openings, a first vacuum panel fixed relative to the perimeter frame segment and configured to reduce heat transfer through the perimeter frame segment, and a second vacuum panel fixed relative to the mullion frame segment and configured to reduce heat transfer through the mullion frame segment.

In some embodiments, at least one of the first vacuum panel and the second vacuum panel includes a plurality of interconnected sub-panels oriented in multiple different directions, a bend disposed at an edge between the plurality of sub-panels, and an evacuated chamber bridging the bend and extending continuously within the plurality of sub-panels.

The foregoing is a summary and thus by necessity contains simplifications, generalizations, and omissions of detail. Consequently, those skilled in the art will appreciate that the summary is illustrative only and is not intended to be in any way limiting. Other aspects, inventive features, and advantages of the devices and/or processes described herein, as defined solely by the claims, will become apparent in the detailed description set forth herein and taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a refrigerated enclosure having multiple doors supported by a thermal frame, according to an exemplary embodiment.

FIG. **2** is a perspective view of a refrigerated enclosure having a single door supported by a thermal frame, according to an exemplary embodiment.

FIG. **3** is a cross-sectional view of the thermal frame of FIG. **1** illustrating a plurality of perimeter frame assemblies and a mullion frame assembly, according to an exemplary embodiment.

FIG. **4** is a cross-sectional view illustrating the perimeter frame assembly of FIG. **3** in greater detail and showing a perimeter frame segment, a mounting bracket, a vacuum panel, and a cover, according to an exemplary embodiment.

FIG. **5** is a perspective view illustrating the perimeter frame segment of FIG. **4** in greater detail, according to an exemplary embodiment.

FIG. **6** is a perspective view illustrating the mounting bracket of FIG. **4** in greater detail, according to an exemplary embodiment.

FIG. **7** is a perspective view illustrating the vacuum panel of FIG. **4** in greater detail, according to an exemplary embodiment.

FIG. **8** is a perspective view illustrating the cover of FIG. **4** in greater detail, according to an exemplary embodiment.

FIG. **9** is a cross-sectional view illustrating the mullion frame assembly of FIG. **3** in greater detail and showing a mullion frame segment, a mounting bracket, a vacuum panel, and a cover, according to an exemplary embodiment.

FIG. **10** is a perspective view illustrating the mullion frame segment of FIG. **9** in greater detail, according to an exemplary embodiment.

FIG. **11** is a perspective view illustrating the mounting bracket of FIG. **9** in greater detail, according to an exemplary embodiment.

FIG. **12** is a perspective view illustrating the cover of FIG. **9** in greater detail, according to an exemplary embodiment.

FIG. **13** is a perspective view illustrating the vacuum panel of FIG. **9** in greater detail, according to an exemplary embodiment.

DETAILED DESCRIPTION

Referring generally to the FIGURES, a thermal frame for a refrigerated enclosure and components thereof are shown, according to various exemplary embodiments. The term "refrigerated" is used herein to refer both to refrigerators at temperatures above freezing and to freezers at temperatures below freezing. The thermal frame described herein may part of a refrigerated enclosure (e.g., a refrigerated display case, a refrigerated merchandiser, a refrigerated storage case, etc.) used in a commercial, institutional, residential, or other setting for storing and/or displaying refrigerated or frozen objects.

The refrigerated enclosure may include a body (e.g., a top wall, a bottom wall, a plurality of side walls, etc.) defining a temperature-controlled space. The thermal frame may include a plurality of frame segments located within the opening and may be configured to support a door or window for accessing items within the temperature-controlled space. The plurality of frame segments may include, for example, perimeter frame segments forming a closed shape along a perimeter of the opening and mullion frame segments dividing the opening into multiple smaller openings. Advantageously, one or more of the frame segments may include a vacuum panel attached thereto. In some embodiments, the vacuum panel is not part of the door, but rather fixed to a segment of the frame to reduce heat transfer through the frame.

The vacuum panel may be attached to a rear surface of a frame segment to provide a layer of thermal insulation between the frame and the temperature-controlled space. The vacuum panel may include a first surface, a second surface offset from the first surface by a thickness, and an evacuated chamber between the first and second surfaces. In some embodiments, the vacuum panel has a thermal resistance between

$$25\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\text{ F.}}{\text{BTU}}$$

and

$$100\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\text{ F.}}{\text{BTU}}$$

per inch of the thickness. The vacuum panel may be bendable and may be contoured around corners of the frame segments. For example, the vacuum panel may be bent into an "L" shape or a "U" shape to allow the vacuum panel to cover adjacent surfaces of the frame segments that are oriented in multiple different directions (e.g., a rear surface, one or more side surfaces, etc.). The evacuated chamber may extend continuously through the bend such that the same evacuated chamber extends along multiple adjacent surfaces of the frame segments.

In some embodiments, the thermal frame includes mounting brackets attached to one or more of the frame segments. The mounting brackets may attach to the frame segments via interlocking grooves, flanges, recesses, lips, or other engagement features. In some embodiments, each mounting bracket defines a channel within which a corresponding frame segment is secured. The mounting brackets may be configured to couple the perimeter frame segments to the refrigerated enclosure and may be configured to secure the vacuum panels to the frame segments. In some embodiments, the mounting brackets define channels within which the vacuum panels are contained. The thermal frame may include covers configured to attach to the mounting brackets and to close the channels containing the vacuum panels.

Referring now to FIGS. **1-2**, a refrigerated enclosure **10** is shown, according to an exemplary embodiment. Refrigerated enclosure **10** may be a refrigerator, freezer, or other enclosure defining a temperature-controlled space. In some embodiments, refrigerated enclosure is a refrigerated display case. Refrigerated enclosure **10** may be implemented, for example, as a refrigerated display case or refrigerated merchandiser in grocery stores, supermarkets, convenience stores, florist shops, and/or other commercial settings to store and display temperature-sensitive consumer goods (e.g., food products and the like). Refrigerated enclosure **10** may be used to display products that must be stored at relatively low temperatures and may include shelves, glass doors, and/or glass walls to permit viewing of the products supported by the shelves. In other embodiments, refrigerated enclosure **10** is a refrigerated storage unit and may be implemented, for example, in warehouses, restaurants, and lounges. Refrigerated enclosure **10** may be a free standing unit or "built in" unit that forms a part of the building in which refrigerated enclosure **10** is located.

Refrigerated enclosure **10** is shown to include a body portion **12**. Body portion **12** may include a top wall **14**, a bottom wall **16**, a left side wall **18**, a right size wall **20**, a rear wall (not shown), and a frontal portion **22** defining a temperature-controlled space. Frontal portion **22** may include an opening into the temperature-controlled space. Thermal frame **24** may be situated at least partially within the opening. Thermal frame **24** is shown to include a plurality of perimeter frame segments (i.e., top frame segment **26**, bottom frame segment **28**, left side frame segment **30**, right side frame segment **32**) forming a closed shape along a perimeter of the opening. In some embodiments, thermal frame **24** includes one or more mullion frame segments **34** dividing the opening into multiple smaller openings. For example, FIG. **1** illustrates a three-door assembly with a pair of mullion frame segments **34** extending between top frame segment **26** and bottom frame segment **28** to divide the opening into three smaller openings. Each of the smaller openings may correspond to a separate door **36** of the three-door assembly. In other embodiments, mullion frame segments **34** may be omitted. For example, FIG. **2** illustrates a one-door assembly wherein thermal frame **24** includes perimeter frame segments **26-32** but not mullion frame segments **34**.

Still referring to FIGS. **1-2**, refrigerated enclosure **10** may include one or more doors **36** pivotally mounted on thermal frame **24** by hinges **38**. In other embodiments, doors **36** may be sliding doors configured to open via linear motion. Doors **36** are shown to include panel assemblies **40** and handles **42**. Referring particularly to FIG. **2**, thermal frame **24** is shown to include a series of contact plates **44**. Contact plates **44** may be attached to a frontal surface of thermal frame **24** and may be configured to provide a sealing surface against which doors **36** rest in the closed position. For example, doors **36** may include a gasket or other sealing feature around a perimeter of each door **36**. In some embodiments, the gaskets employ a flexible bellows and magnet arrangement. When doors **36** are closed, the gaskets may engage contact plates **44** to provide a seal between doors **36** and thermal frame **24**.

Referring now to FIG. **3**, a cross-sectional plan view of refrigerated enclosure **10** taken along the line **3-3** in FIG. **1** is shown, according to an exemplary embodiment. Refrigerated enclosure **10** is shown to include a body portion **12** having a frontal portion **22**, a pair of side walls **18** and **20** extending rearwardly from frontal portion **22**, and a rear wall **46** extending between side walls **18** and **20** to define a temperature-controlled space **48** within body portion **12**.

In FIG. **3**, refrigerated enclosure **10** is shown as a two-door assembly with a pair of doors **36** positioned in an opening in frontal portion **22**. In various embodiments, refrigerated enclosure **10** may have two doors **36** (as shown in FIG. **3**), a lesser number of doors **36** (i.e., a single door as shown in FIG. **2**), or a greater number of doors **36** (i.e., three or more doors as shown in FIG. **1**). Each door **36** may include a panel assembly **40** and a handle **42**. Applying a force to handle **42** may cause the corresponding door **36** to rotate about hinges **38** between an open position and a closed position. In some embodiments, panel assembly **40** is a transparent panel assembly through which items within temperature-controlled space **48** can be viewed when doors **36** are in the closed position. For example, panel assembly **40** is shown to include a plurality of transparent panels **50** with spaces **52** therebetween. Spaces **52** may be sealed and filled with an insulating gas (e.g., argon) or evacuated to produce a vacuum between panels **50**. In other embodiments, panel assembly **40** may include opaque panels with an insulating foam or other insulator therebetween. Doors **36** are shown to include gaskets **54** attached to a rear surface of doors **36** along an outer perimeter of each door. Gaskets **54** may be configured to engage contact plates **44***a* and **44***b* (referred to collectively as contact plates **44**) when doors **36** are in the closed position to provide a seal between doors **36** and contact plates **44**.

Still referring to FIG. **3**, thermal frame **24** is illustrated in greater detail, according to an exemplary embodiment. Each perimeter frame segment **30-32** may be coupled to body portion **12** via a mounting bracket **66**. Mounting brackets **66** may be secured to perimeter frame segments **30-32** using one or more connection features (e.g., flanges, notches, grooves, collars, lips, etc.) or fasteners (e.g., bolts, screws, clips, etc.) and may hold perimeter frame segments **30-32** in a fixed position relative to body portion **12**.

In some embodiments, mounting brackets **66** include a plurality of interconnected walls that define a front channel configured to receive perimeter frame segments **30-32** and a rear channel configured to receive vacuum panels **64**. The rear channel may include at least one bend such that the rear channel extends along a rear surface of perimeter frame segments **30-32** and a side surface of perimeter frame segments **30-32**. Vacuum panels **64** may be positioned within the rear channels to provide a layer of thermal insulation along the rear surface and/or side surface of perimeter frame segments **30-32**. Covers **68** may be attached to mounting brackets **66** to close the rear channels and contain vacuum panels **64** therein.

Although only two perimeter frame segments **30-32** are shown in FIG. **3**, other perimeter frame segments (e.g., top frame segment **26**, bottom frame segment **28**, etc.) may be configured in a similar manner. For example, top frame segment **26** and bottom frame segment **28** may be coupled to body portion **12** via mounting brackets **66**. Mounting brackets **66** may be configured to receive and secure vacuum panels **64** along a rear surface of frame segments **26-28** and/or a side surface of frame segments **26-28**. A perimeter frame segment assembly including a perimeter frame segment (i.e., one of frame segments **26-32**), mounting bracket **66**, vacuum panel **64**, and cover **68** is described in greater detail with reference to FIGS. **4-8**.

Mullion frame segment **34** may extend vertically between top frame segment **26** and bottom frame segment **28**. In some embodiments, a top portion of mullion frame segment **34** is fastened to top frame segment **26** and a bottom portion of mullion frame segment **34** is fastened to bottom frame segment **28**. Mounting bracket **76** may be secured to mullion frame segment **34** via one or more connection features (e.g., flanges, notches, grooves, collars, lips, etc.) or fasteners (e.g., bolts, screws, clips, etc.) that hold mounting bracket **76** in a fixed position relative to mullion frame segment **34**.

In some embodiments, mounting bracket **76** includes a plurality of interconnected walls that define a front channel configured to receive mullion frame segment **34** and a rear channel configured to receive vacuum panel **74**. The rear channel may include at least one bend such that the rear channel extends along a rear surface of mullion frame segment **34** and one or more side surfaces of mullion frame segment **34**. Vacuum panel **74** may be positioned within the rear channel to provide a layer of thermal insulation along the rear surface and/or side surface of mullion frame segment **34**. Cover **78** may be attached to mounting bracket **76** to close the rear channel and contain vacuum panel **74** therein. A mullion frame segment assembly including mullion frame segment **34**, mounting bracket **76**, vacuum panel **74**, and cover **78** is described in greater detail with reference to FIGS. **9-13**.

Referring now to FIGS. **4-8**, a perimeter frame segment assembly **60** and components thereof are shown, according to an exemplary embodiment. Assembly **60** is shown to include a perimeter frame segment **62** (i.e., one of frame segments **26-32**), mounting bracket **66**, vacuum panel **64**, and cover **68**. FIG. **4** is a cross-sectional view of assembly **60** and FIGS. **5-8** are perspective views illustrating segments of components **62-68**. Although only short segments of components **62-68** are shown in FIGS. **5-8**, it is understood that components **62-68** may have any length in various embodiments. For example, assembly **60** may extend vertically between top frame segment **26** and bottom frame segment **28**. In some embodiments, perimeter frame segment **62** is made from a metallic material (e.g., aluminum, steel, etc.). Mounting bracket **66** may be made from a rigid or substantially rigid insulator such as PVC or another polymer and may be configured to provide thermal insulation between perimeter frame segment **62** and body portion **12**.

Perimeter frame segment **62** is shown to include a plurality of connected walls **81-86** that define the general shape of perimeter frame segment **62**. Wall **81** may extend along frontal portion **22** of refrigerated enclosure **10** (as shown in FIG. **3**) and may be visible from the front of refrigerated enclosure **10** when doors **36** are closed (as shown in FIGS. **1-2**). Wall **82** may extend rearwardly from frontal portion **22** (i.e., toward rear wall **46**) through the opening in body portion **12** and may be connected to wall **81** along an inner edge **124** of wall **81**. Inner edge **124** may be the edge of wall **81** that is closest to the opening in body portion **12**.

Wall **84** may extend in a second direction (i.e., other than rearwardly, to the right in FIG. **4**) from a rearward edge **126** of wall **82**. In some embodiments, wall **84** is oriented substantially perpendicular to wall **82** and may extend toward the opposite frame segment of thermal frame **24**. For example, if perimeter frame segment **62** is the left side frame segment **30**, wall **84** may extend toward right side frame segment **32**. If perimeter frame segment **62** is bottom frame segment **28**, wall **84** may extend toward top frame segment **26**. Wall **84** is shown to include a first end **128** proximate to wall **82** and a second end **130** opposite first end **128**.

Wall **86** may extend from wall **84** toward frontal portion **22** of refrigerated enclosure **10**. In some embodiments, wall **86** is oriented substantially perpendicular to wall **84**. Wall **86** may extend from second end **130** of wall **84** to define a channel **88** between walls **82**, **84**, and **86**. In some embodiments, channel **88** is a "C-shaped" or "U-shaped" channel with an open front. Contact plate **44***a* may extend between walls **82** and **86**, thereby closing channel **88**. Contact plate **44***a* may be held in place with a retaining clip **132** (e.g., a zipper strip or other suitable fastening device). Retaining clip **132** may be coupled to wall **86** via an engagement feature **134** (e.g., a flange, a notch, a lip, a collar, a groove, etc.) of wall **86**.

In some embodiments, perimeter frame segment **62** includes a support **87** within channel **88**. Support **87** may be configured to secure a heater wire **89** within channel **88** and to ensure that heater wire **89** maintains contact with contact plate **44***a*.

Still referring to FIGS. **4-8**, mounting bracket **66** may be configured to secure perimeter frame segment **62** to the perimeter of the opening in body portion **12** and to support vacuum panel **64**. Mounting bracket **66** may be attached to perimeter frame segment **62** via one or more engagement features (e.g., flange **125**, collar **127**, flange **129**, grooves, notches, etc.) and/or fasteners and may be fixed to an inner perimeter of the opening in body portion **12**.

Mounting bracket **66** is shown to include a plurality of walls **92-102** that define the general shape of mounting bracket **66**. Wall **92** may be disposed between wall **82** of perimeter frame segment **62** and the perimeter of the opening in body portion **12**. Wall **92** may extend rearwardly from frontal portion **22** through the opening in body portion **12**.

Wall **94** may be disposed rearward of wall **84** (e.g., between wall **84** and vacuum panel **64**) and may extend in the second direction (e.g., to the right in FIG. **4**) from a rearward edge **136** of wall **92**. In some embodiments, wall **94** is oriented substantially perpendicular to wall **92** and may extend toward the opposite frame segment of thermal frame **24**. Wall **94** is shown to include a first end **138** proximate wall **92** and a second end **140** opposite first end **138**.

Wall **96** may extend from wall **94** toward frontal portion **22** of refrigerated enclosure **10**. In some embodiments, wall **96** is oriented substantially perpendicular to wall **94**. Wall **96** may extend from second end **140** of wall **84** to define a front channel **104** between walls **92**, **94**, and **96**. In some embodiments, front channel **104** is a "C-shaped" or "U-shaped" channel with an open front. Perimeter frame segment **62** may be located at least partially within front channel **104**.

In some embodiments, mounting bracket **66** includes a wall **98** extending rearwardly from first end **138** of wall **94**. Mounting bracket **66** may include a wall **102** offset from wall **98** in the second direction (e.g., to the right in FIG. **4**) and coupled to second end **140** of wall **94**. Wall **102** may be coupled to wall **94** directly (e.g., extending from wall **94**) or indirectly (e.g., via one or more intermediate walls **96** and **100**, as shown in FIG. **4**). Walls **94**, **98**, and **102** may at least partially define a rear channel **106** within which vacuum panel **64** is contained. Wall **100** may extend between walls **96** and **102** to define a portion of rear channel **106** between walls **96**, **100**, and **102**. In some embodiments, rear channel **106** includes a bend such that rear channel **106** extends along multiple adjacent surfaces of perimeter frame segment **62** (e.g., along walls **84** and **86**).

Cover **68** may extend between walls **98** and **102** to close rear channel **106** and secure vacuum panel **64** therein. In some embodiments, cover **68** includes engagement features **120** at each end of cover **68**. Mounting bracket **66** may include corresponding engagement features **122** along rearward ends of walls **98** and **106**. Features **120** may be configured to engage features **122** to secure cover **68** to mounting bracket **66** and hold vacuum panel **64** within rear channel **106**. In some embodiments, cover **68** includes a seal **142** attached to an end thereof (e.g., extending from engagement feature **120**). Seal **142** may be made of a flexible material such as flexible PVC, rubber, or another polymer. Seal **142** may be configured to provide a seal between cover **68** and mounting bracket **66** when cover **68** is secured to mounting bracket **66**.

Still referring to FIGS. **4-8**, vacuum panel **64** may positioned rearward of perimeter frame segment **62** and may be configured to reduce heat transfer through perimeter frame segment **62**. Vacuum panel **64** may be located within rear channel **106** and may extend along multiple adjacent surfaces of perimeter frame segment **62** (e.g., along walls **84** and **86**). Vacuum panel **64** may include a front surface **108**, a rear surface **110**, and an evacuated chamber **112** between surfaces **108** and **110**. Rear surface **110** may be offset from front surface **108** by a thickness. In some embodiments, vacuum panel **64** has a thermal resistance between

$$25\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\ \text{F.}}{\text{BTU}}$$

and

$$100\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\ \text{F.}}{\text{BTU}}$$

per inch of the thickness of evacuated chamber **112**.

In some embodiments, vacuum panel **64** includes at least one bend **118** and evacuated chamber **112** is a continuous chamber bridging bend **118**. For example, vacuum panel **64** is shown to include a surface **114** extending from front surface **108** toward frontal portion **22** and a surface **116** extending from surface **110** toward frontal portion **22**. Surface **116** may be offset from surface **114** by the thickness of evacuated chamber **112** in the second direction (e.g., to the right in FIG. **4**). Evacuated chamber **112** may extend between surfaces **114** and **116** such that evacuated chamber **112** extends through bend **118** and provides thermal insulation for both wall **84** and wall **86** of perimeter frame segment **62**.

In some embodiments, perimeter frame segment assembly **60** includes a lighting element (e.g., an LED strip, a fluorescent tube, an incandescent bulb, etc.) attached to one or more of components **62-68** and configured to illuminate the interior of refrigerated enclosure **10**. The lighting element may be disposed along a rear surface of cover **68** and configured to emit light toward items within temperature-controlled space **48**. In some embodiments, assembly **60** includes a mounting plate positioned between cover **68** and vacuum panel **64**. The mounting plate may include one or more studs that extend through cover **68** and attach to the lighting element rearward of cover **68**. Advantageously, the mounting plate may allow the lighting element to be attached to assembly **60** without puncturing vacuum panel **64**. In other embodiments, the lighting element may be secured to assembly **60** via a channel system along the rear surface of cover **68**, via one or more fasteners (e.g., snap fittings, structural adhesive tape, bolts, screws, etc.), or any other means for attaching the lighting element to assembly **60**. In some embodiments, assembly **60** includes a wireway (e.g., a channel, a path, a guide, etc.) configured to route a power wire and/or signal wire from the lighting element to assembly **60**. The wireway may be attached to a top of bottom of assembly **60** to cover a wiring connection between the lighting element and assembly **60**.

Referring now to FIGS. **9-13**, a mullion frame segment assembly **70** and components thereof are shown, according to an exemplary embodiment. Assembly **70** is shown to include a mullion frame segment **72** (i.e., one of mullion frame segments **34**), mounting bracket **76**, vacuum panel **74**, and cover **78**. FIG. **9** is a cross-sectional view of assembly **70** and FIGS. **10-13** are perspective views illustrating segments of components **72-78**. Although only short segments of components **72-78** are shown in FIGS. **10-13**, it is understood that components **72-78** may have any length in various embodiments. For example, assembly **70** may extend vertically between top frame segment **26** and bottom frame segment **28**. In some embodiments, mullion frame segment **72** is made from a metallic material (e.g., aluminum, steel, etc.). Mounting bracket **76** may be made from a rigid or substantially rigid insulator such as PVC or another polymer and may be configured to provide thermal insulation between mullion frame segment **72** and the temperature-controlled space **48**.

Mullion frame segment **72** is shown to include a plurality of connected walls **152-156** that define the general shape of mullion frame segment **72**. In some embodiments, mullion frame segment **72** is offset rearward of frontal portion **22** such that contact plate **44*b*** is substantially aligned with contact plate **44*a*** (as shown in FIG. **3**). Wall **152** may extend rearwardly from contact plate **44*b***, toward rear wall **46** of refrigerated enclosure **10**. Wall **154** may extend in a second direction (i.e., other than rearwardly, to the right in FIG. **9**) from a rearward edge of wall **152**. In some embodiments, wall **154** is oriented substantially perpendicular to wall **152**. Wall **156** may extend from wall **154** toward frontal portion **22** of refrigerated enclosure **10** and may be oriented substantially perpendicular to wall **154**.

Wall **156** may extend from an end of wall **154** opposite wall **152** to define a channel **158** between walls **152**, **154**, and **156**. In some embodiments, channel **158** is a "C-shaped" or "U-shaped" channel with an open front. Contact plate **44*b*** may extend between walls **152** and **156**, thereby closing channel **158**. Contact plate **44*b*** may be held in place by one or more retaining clips **196** (e.g., zipper strips or other suitable fastening devices). Retaining clips **196** may be coupled to walls **152** and/or **156** via an engagement feature **157** (e.g., a flange, a notch, a lip, a collar, a groove, etc.) of walls **152** and/or walls **156**.

In some embodiments, mullion frame segment **72** includes a first inverted fillet **153** at the intersection of walls **152** and **154**, and a second inverted fillet **155** at the intersection of walls **154** and **156**. Inverted fillets **153** and **155** may include a convex surface along an interior of channel **158** and a concave surface along an exterior of channel **158**. In some embodiments, mullion frame segment **72** includes supports **151** within channel **158**. Supports **151** may be configured to secure a heater wire **198** within channel **158** and to ensure that heater wire **198** maintains contact with contact plate **44*b***.

Still referring to FIGS. **9-13**, mounting bracket **76** may be configured to attach vacuum panel **74** to mullion frame segment **72**. Mounting bracket **76** may be attached to mullion frame segment **72** via one or more engagement features (e.g., flanges **191**, grooves **193**, etc.) and/or fasteners. Mounting bracket **76** is shown to include a plurality of walls **162-174** that define the general shape of mounting bracket **76**. Wall **162** may be disposed between wall **152** of mullion frame segment **72** and a portion of vacuum panel **74**. Wall **162** may extend rearwardly relative to frontal portion **22** and may be substantially aligned with wall **152**.

Wall **164** may be disposed rearward of wall **154** (e.g., between wall **154** and vacuum panel **74**) and may extend in the second direction (e.g., to the right in FIG. **9**) from a rearward edge **200** of wall **162**. In some embodiments, wall **164** is oriented substantially perpendicular to wall **162**. Wall **164** is shown to include a first end **202** proximate wall **162** and a second end **204** opposite first end **202**.

Wall **166** may extend from wall **164** toward frontal portion **22** of refrigerated enclosure **10**. In some embodiments, wall **166** is oriented substantially perpendicular to wall **164**. Wall **166** may extend from second end **204** of wall **184** to define a front channel **206** between walls **162**, **164**, and **166**. In some embodiments, front channel **206** is a "C-shaped" or "U-shaped" channel with an open front. Mullion frame segment **72** may be located at least partially within front channel **206**.

In some embodiments, mounting bracket **76** includes a wall **168** coupled to first end **202** of wall **164** and extending rearward of wall **164**. Wall **168** may be coupled to wall **164** directly (e.g., extending rearward from wall **164**) or via one or more intermediate walls (e.g., walls **162** and **172**, as shown in

FIG. **9**). Mounting bracket **76** may include a wall **170** coupled to second end **204** of wall **164** and extending rearward of wall **164**. Wall **170** may be coupled to wall **164** directly (e.g., extending rearward from wall **164**) or via one or more intermediate walls (e.g., walls **166** and **174**, as shown in FIG. **9**). Walls **164**, **168**, and **170** may at least partially define a rear channel **208** within which vacuum panel **74** is contained.

In some embodiments, wall **170** is offset from wall **166** in the second direction (e.g., to the right in FIG. **9**). Mounting bracket **76** may include a wall **174** extending between wall **166** and wall **170** to define a portion of rear channel **208** between wall **166**, wall **170**, and wall **174**. In some embodiments, wall **168** is offset from wall **162** in a third direction opposite the second direction (e.g., to the left in FIG. **9**). Mounting bracket **76** may include a wall **172** extending between wall **162** and wall **168** to define a portion of rear channel **208** between wall **162**, wall **168**, and wall **172**. In some embodiments, rear channel **208** includes one or more bends such that rear channel **208** extends along multiple adjacent surfaces of mullion frame segment **72** (e.g., along wall **152**, wall **154**, and/or wall **156**).

Cover **78** may extend between walls **168** and **170** to close rear channel **208** and secure vacuum panel **74** therein. In some embodiments, cover **78** includes engagement features **210** at each end of cover **78**. Mounting bracket **76** may include corresponding engagement features **212** along rearward ends of walls **168** and **170**. Features **210** may be configured to engage features **212** to secure cover **78** to mounting bracket **76** and hold vacuum panel **74** within rear channel **208**. In some embodiments, cover **78** includes one or more seals **194** attached to ends thereof (e.g., extending from engagement features **210**). Seals **194** may be made of a flexible material such as flexible PVC, rubber, or another polymer. Seals **194** may be configured to provide a seal between cover **78** and mounting bracket **76** when cover **78** is secured to mounting bracket **76**.

Still referring to FIGS. **9-13**, vacuum panel **64** may positioned rearward of mullion frame segment **72** and may be configured to reduce heat transfer through mullion frame segment **72**. Vacuum panel **74** may be located within rear channel **208** and may extend along multiple adjacent surfaces of mullion frame segment **72** (e.g., along walls **152**, **154**, and/or **156**). Vacuum panel **74** may include a front surface **180**, a rear surface **182**, and an evacuated chamber **184** between surfaces **180** and **182**. Rear surface **182** may be offset from front surface **180** by a thickness. In some embodiments, vacuum panel **74** has a thermal resistance between

$$25\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\ \text{F.}}{\text{BTU}}$$

and

$$100\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\ \text{F.}}{\text{BTU}}$$

per inch of the thickness of evacuated chamber **184**.

In some embodiments, vacuum panel **64** includes one or more bends (e.g., bends **185** and/or **189**) and evacuated chamber **184** is a continuous chamber bridging the one or more bends. For example, vacuum panel **74** is shown to include a surface **186** extending from front surface **180** toward frontal portion **22**, and a surface **188** extending from surface **182** toward frontal portion **22**. Surface **188** may be offset from surface **186** by the thickness of evacuated chamber **184** in the second direction (e.g., to the right in FIG. **9**). Evacuated chamber **184** may extend between surfaces **186** and **188** such that evacuated chamber **184** extends through bend **185** and provides thermal insulation for both wall **154** and wall **156** of mullion frame segment **72**. Vacuum panel **74** may also include a surface **190** extending from front surface **180** toward frontal portion **22**, and a surface **192** extending from surface **182** toward frontal portion **22**. Surface **192** may be offset from surface **190** by the thickness of evacuated chamber **184** in a third direction opposite the second direction (e.g., to the left in FIG. **9**). Evacuated chamber **184** may extend between surfaces **190** and **192** such that evacuated chamber **184** extends through bend **189** and provides thermal insulation for both wall **152** and wall **154** of mullion frame segment **72**.

In some embodiments, mullion frame segment assembly **70** includes a lighting element (e.g., an LED strip, a fluorescent tube, an incandescent bulb, etc.) attached to one or more of components **72-78** and configured to illuminate the interior of refrigerated enclosure **10**. The lighting element may be disposed along a rear surface of cover **78** and configured to emit light toward items within temperature-controlled space **48**. In some embodiments, assembly **70** includes a mounting plate positioned between cover **78** and vacuum panel **74**. The mounting plate may include one or more studs that extend through cover **78** and attach to the lighting element rearward of cover **78**. Advantageously, the mounting plate may allow the lighting element to be attached to assembly **70** without puncturing vacuum panel **74**. In other embodiments, the lighting element may be secured to assembly **70** via a channel system along the rear surface of cover **78**, via one or more fasteners (e.g., snap fittings, structural adhesive tape, bolts, screws, etc.), or any other means for attaching the lighting element to assembly **70**. In some embodiments, assembly **70** includes a wireway (e.g., a channel, a path, a guide, etc.) configured to route a power wire and/or signal wire from the lighting element to assembly **70**. The wireway may be attached to a top of bottom of assembly **70** to cover a wiring connection between the lighting element and assembly **70**.

In any embodiment, thermal frame **24** may include a perimeter frame **62** segment fixed to refrigerated enclosure **10** along a perimeter of the opening and/or a mullion frame **72** segment fixed to refrigerated enclosure **10** and dividing the opening into a plurality of smaller openings. Thermal frame **24** may include a first vacuum panel **64** fixed relative to perimeter frame segment **62** and configured to reduce heat transfer through perimeter frame segment **62** and/or a second vacuum panel **74** fixed relative to mullion frame segment **72** and configured to reduce heat transfer through mullion frame segment **72**. In some embodiments, each vacuum panel is located at least partially rearward of the frame segment to which the vacuum panel is attached.

Any of the vacuum panels may include a plurality of interconnected sub-panels oriented in multiple different directions and connected by one or more bends (e.g., bends **118**, **185**, and/or **189**) located at an edge between the plurality of sub-panels. Each vacuum panel may include an evacuated chamber (e.g., chamber **112** and/or **184**) bridging the bends and extending continuously within the plurality of sub-panels. Advantageously, the vacuum panels may extend along multiple adjacent surfaces of the corresponding frame segments for improved thermal insulation.

As utilized herein, the terms "approximately," "about," "substantially," and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numerical ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and claimed are considered to be within the scope of the invention as recited in the appended claims.

It should be noted that the term "exemplary" as used herein to describe various embodiments is intended to indicate that such embodiments are possible examples, representations, and/or illustrations of possible embodiments (and such term is not intended to connote that such embodiments are necessarily extraordinary or superlative examples).

The terms "coupled," "connected," "attached," "secured" and the like as used herein mean the joining of two members directly or indirectly to one another. Such joining may be stationary (e.g., permanent) or moveable (e.g., removable or releasable). Such joining may be achieved with the two members or the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional intermediate members being attached to one another.

It should be noted that the orientation of various elements may differ according to other exemplary embodiments, and that such variations are intended to be encompassed by the present disclosure.

It is also important to note that the construction and arrangement of the refrigerated case with thermal door frame as shown in the various exemplary embodiments is illustrative only. Although only a few embodiments of the present inventions have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter disclosed herein. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied. Accordingly, all such modifications are intended to be included within the scope of the present invention as defined in the appended claims. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes and omissions may be made in the design, operating conditions and arrangement of the various exemplary embodiments without departing from the scope of the present inventions.

What is claimed is:

1. A thermal frame for an opening in a refrigerated enclosure, the thermal frame comprising:

a perimeter frame segment configured to be fixed to a refrigerated enclosure along a perimeter of an opening of the refrigerated enclosure, the perimeter frame segment comprising:

a first wall configured to extend rearwardly from a frontal portion of the refrigerated enclosure,

a second wall extending in a second direction from a rearward edge of the first wall, and

a third wall configured to extend from the second wall toward the frontal portion of the refrigerated enclosure to define a first channel between the first, second, and third walls;

a vacuum panel fixed relative to the perimeter frame segment and comprising:

a first surface disposed rearward of the second wall,

a second surface disposed rearward of the first surface and offset from the first surface by a thickness, and

an evacuated chamber between the first and second surfaces; and

a mounting bracket configured to secure the perimeter frame segment to the perimeter of the opening and to support the vacuum panel, the mounting bracket comprising:

a fifth wall disposed between the second wall of the perimeter frame segment and the first surface of the vacuum panel,

a seventh wall coupled to a first end of the fifth wall and extending rearward of the fifth wall,

an eighth wall coupled to a second end of the fifth wall opposite the first end, and extending rearward of the fifth wall, wherein the fifth, seventh, and eighth walls at least partially define a third channel within which the vacuum panel is contained,

a sixth wall configured to extend from the second end of the fifth wall toward the frontal portion of the refrigerated enclosure, wherein the eighth wall is offset from the sixth wall in the second direction, and

a ninth wall extending between the sixth wall and the eighth wall to define a portion of the third channel between the sixth, eighth, and ninth walls.

2. The thermal frame of claim **1**, wherein the vacuum panel is configured to reduce heat transfer through the perimeter frame segment.

3. The thermal frame of claim **1**, wherein the vacuum panel has a thermal resistance between

$$25\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\text{ F.}}{\text{BTU}}$$

per inch of the thickness and

$$\frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\text{ F.}}{\text{BTU}}$$

100 per inch of the thickness.

4. The thermal frame of claim **1**, wherein the vacuum panel comprises at least one bend and the evacuated chamber is a continuous chamber bridging the bend.

5. The thermal frame of claim **1**, wherein the vacuum panel further comprises:

a third surface configured to extend from the first surface toward the frontal portion of the refrigerated enclosure; and

a fourth surface configured to extend from the second surface toward the frontal portion of the refrigerated enclosure and offset from the third surface by the thickness in the second direction;

wherein the evacuated chamber extends between the third and fourth surfaces.

6. The thermal frame of claim **1**, wherein the mounting bracket comprises:

a fourth wall configured to be disposed between the first wall of the perimeter frame segment and the perimeter of the opening;

the fifth wall disposed between the second wall of the perimeter frame segment and the first surface of the vacuum panel and extending in the second direction from a rearward edge of the fourth wall; and

the sixth wall configured to extend from the fifth wall toward the frontal portion of the refrigerated enclosure to define a second channel between the fourth, fifth, and sixth walls;

wherein the perimeter frame segment is located at least partially within the second channel.

7. The thermal frame of claim **1**, further comprising a cover extending between the seventh and eighth walls and closing the third channel.

8. The thermal frame of claim **7**, wherein the cover comprises:

a first engagement feature located along a first edge of the cover and configured to engage a corresponding engagement feature of the seventh wall; and

a second engagement feature located along a second edge of the cover and configured to engage a corresponding engagement feature of the eighth wall.

9. The thermal frame of claim **1**, further comprising a contact plate extending between the first and third walls and closing the first channel.

10. A thermal frame for an opening in a refrigerated enclosure, the thermal frame comprising:

a mullion frame segment configured to be fixed to a refrigerated enclosure and configured to divide an opening of the refrigerated enclosure into a plurality of smaller openings, the mullion frame segment comprising:

a first wall configured to extend rearwardly relative to a frontal portion of the refrigerated enclosure,

a second wall extending in a second direction from a rearward edge of the first wall, and

a third wall configured to extend from the second wall toward the frontal portion of the refrigerated enclosure to define a first channel between the first, second, and third walls;

a vacuum panel fixed relative to the mullion frame segment and comprising:

a first surface disposed rearward of the second wall,

a second surface disposed rearward of the first surface and offset from the first surface by a thickness, and

an evacuated chamber between the first and second surfaces;

a mounting bracket configured to secure the vacuum panel to the mullion frame segment, the mounting bracket comprising:

a fifth wall disposed between the second wall of the mullion frame segment and the first surface of the vacuum panel,

a seventh wall coupled to a first end of the fifth wall and extending rearward of the fifth wall, wherein the seventh wall is offset from the first wall in a third direction opposite the second direction,

an eighth wall coupled to a second end of the fifth wall opposite the first end, and extending rearward of the fifth wall, wherein the fifth, seventh, and eighth walls at least partially define a third channel within which the vacuum panel is contained,

a fourth wall configured to extend from the first end of the fifth wall toward the frontal portion of the refrigerated enclosure; and

a ninth wall extending between the fourth wall and the seventh wall to define a portion of the third channel between the fourth, seventh, and ninth walls.

11. The thermal frame of claim **10**, wherein the vacuum panel is configured to reduce heat transfer through the mullion frame segment.

12. The thermal frame of claim **10**, wherein the vacuum panel has a thermal resistance between

$$25\ \frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\text{F.}}{\text{BTU}}$$

per inch of the thickness and

$$\frac{\text{hr}\cdot\text{ft}^2\cdot{}^\circ\text{F.}}{\text{BTU}}$$

100 per inch of the thickness.

13. The thermal frame of claim **10**, wherein the vacuum panel comprises at least one bend and the evacuated chamber is a continuous chamber bridging the bend.

14. The thermal frame of claim **10**, wherein the vacuum panel further comprises:

a third surface configured to extend from a first edge of the first surface toward the frontal portion of the refrigerated enclosure; and

a fourth surface configured to extend from a first edge of the second surface toward the frontal portion of the refrigerated enclosure and offset from the third surface by the thickness in the second direction;

wherein the evacuated chamber extends between the third and fourth surfaces.

15. The thermal frame of claim **14**, wherein the vacuum panel further comprises:

a fifth surface configured to extend from a second edge of the first surface and toward the frontal portion of the refrigerated enclosure; and

a sixth surface configured to extend from a second edge of the second surface toward the frontal portion of the refrigerated enclosure and offset from the fifth surface by the thickness in the third direction opposite the second direction;

wherein the evacuated chamber extends between the fifth and sixth surfaces.

16. The thermal frame of claim **10**, wherein the mullion frame segment comprises an inverted fillet connecting the second wall with at least one of the first wall and the third wall, the inverted fillet comprising a convex surface along an interior of the first channel and a concave surface along an exterior of the first channel.

17. The thermal frame of claim **10**, wherein the mounting bracket comprises:

a fourth wall extending rearwardly along an exterior surface of the first wall;

the fifth wall disposed between the second wall of the mullion frame segment and the first surface of the vacuum panel and extending in the second direction from a rearward edge of the fourth wall; and

a sixth wall configured to extend from the fifth wall toward the frontal portion of the refrigerated enclosure to define a second channel between the fourth, fifth, and sixth walls;

wherein the mullion frame segment is located at least partially within the second channel.

18. The thermal frame of claim **10**, further comprising a cover extending between the seventh and eighth walls and closing the third channel.

19. The thermal frame of claim **18**, wherein the cover comprises:

a first engagement feature located along a first edge of the cover and configured to engage a corresponding engagement feature of the seventh wall; and

a second engagement feature located along a second edge of the cover and configured to engage a corresponding engagement feature of the eighth wall.

20. A thermal frame for an opening in a refrigerated enclosure, the thermal frame comprising:

a mullion frame segment configured to be fixed to a refrigerated enclosure and configured to divide an opening of the refrigerated enclosure into a plurality of smaller openings, the mullion frame segment comprising:

a first wall configured to extend rearwardly relative to a frontal portion of the refrigerated enclosure,

a second wall extending in a second direction from a rearward edge of the first wall, and

a third wall configured to extend from the second wall toward the frontal portion of the refrigerated enclosure to define a first channel between the first, second, and third walls;

a vacuum panel fixed relative to the mullion frame segment and comprising:

a first surface disposed rearward of the second wall,

a second surface disposed rearward of the first surface and offset from the first surface by a thickness, and

an evacuated chamber between the first and second surfaces;

a mounting bracket configured to secure the vacuum panel to the mullion frame segment, the mounting bracket comprising:

a fifth wall disposed between the second wall of the mullion frame segment and the first surface of the vacuum panel,

a seventh wall coupled to a first end of the fifth wall and extending rearward of the fifth wall,

an eighth wall coupled to a second end of the fifth wall, opposite the first end, and extending rearward of the fifth wall, wherein the eighth wall is offset from the third wall in the second direction, wherein the fifth, seventh, and eighth walls at least partially define a third channel within which the vacuum panel is contained,

a sixth wall configured to extend from the second end of the fifth wall toward the frontal portion of the refrigerated enclosure; and

a tenth wall extending between the sixth wall and the eighth wall to define a portion of the third channel between the sixth, eighth, and tenth walls.

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